NUCLEAR SCIENCE ABSTRACTS

Volume 27 Number 9

Abstracts 19422-22040

May 15, 1973

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NUCLEAR SCIENCE ABSTRACTS

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Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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Personal Authors

Each author's name is indexed in the form appearing on the document abstracted:

NEWCOMB, William A., Stability of a magnetic well, 25:1239
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TRANSURANIUM ELEMENTS
determination in bone ash, radiochemical method for, 25:40 (IDO-12073, pp 28-36)
separation by ion exchange and complex-formation elution, 25:251(P)
TRIETHYLENETETRAMINE
complexes with cobalt(III) and rhodium(III) chlorides, radiation effects on labeled, thermal-neutron, 25:137
TRITIUM
content in Cattaraugus Creek near West Valley Processing Plant, July through Dec. 1969, 25:258 (DOCKET-50201-48)
content in Cattaraugus Creek near West Valley Processing Plant, Jan. to July 1970, 25:259 (DOCKET-50201-49)
determination in luminescent material by scintillation counting, 25:40 (IDO-12073, pp 28-36)

Corporate Authors

Technical report literature is indexed from the name of the organization or institution responsible for the issuance of the report.

372 (UCRL-72739) CONSTRUCTION OF A UNIQUE UNDERGROUND WHOLE BODY COUNTER. Griffith, R. V.; Anderson, A. L.; Lindeken, C. L. **(California Univ., Livermore. Lawrence Radiation Lab.).** Oct 1970. 27p. (CONF-701009-1). Dep. NTIS.

is indexed as:

CALIFORNIA UNIV., LIVERMORE. LAWRENCE RADIATION LAB.
Construction of a unique underground whole body counter, 25:372 (UCRL-72739)

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4270(Vol.2)	25-614	Dep. NTIS
4606	25-1530	Dep. NTIS
ORNL-IBP-		
70-3	25-2025	Dep. NTIS
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Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

TABLE OF CONTENTS

Volume 27, Number 9, May 15, 1973

Category	Page
CHEMISTRY	1833
Analytical Chemistry	1833
Activation and Nuclear Reaction Procedures	1833
Chemical and Spectral Procedures	1836
Radiometric and Radiochemical Procedures	1841
Separation Procedures	1843
Inorganic, Organic, and Physical Chemistry	1846
Chemical and Physicochemical Properties	1846
Isotope Effects	1847
Isotope Exchange and Isotope Separation	1849
Feed Materials Processing	1850
Radiation Chemistry	1850
Radiochemistry and Nuclear Chemistry	1856
Hot-Atom Chemistry	1857
Properties of Radioactive Materials	1858
Radioactive Waste Treatment	1862
Radioisotope Production	1863
Reactor Fuel Reprocessing	1865
ENGINEERING	1866
Energy Conversion	1866
Facilities and Equipment	1866
Heat Transfer and Fluid Flow	1867
Materials Testing	1868
Nuclear Explosions	1868
Protective Structures and Equipment	1869
Safety Engineering	1869
Vacuum Engineering	1869
ENVIRONMENTAL AND EARTH SCIENCES	1871
Minerals and Ores	1871
Radioactive Effluents	1871
Radioactivity Monitoring and Transport	1871
Atmosphere	1872
Soil	1873
Water	1874
Ecosystems and Food Cycles	1874
Radiometric Techniques	1874
Site Surveys	1875
Thermal Effluents	1876
INSTRUMENTATION	1877
Radiation Detection Instruments	1877
General Detectors and Monitors	1877
Radiation Dosimeters	1879
Nuclear Spectroscopic Instrumentation	1880
High Energy Physics Instrumentation	1882
Radiometric Instruments	1883
Radiation Effects on Instrument Components, Instruments, or Electronic Systems	1885
Miscellaneous Instruments	1885
ISOTOPE AND RADIATION SOURCE TECHNOLOGY	1887
Isotope Separation (Industrial)	1887
Isotopic Power Sources	1887
Radiation Sources	1888
Design and Fabrication	1888
Industrial Uses	1888

Category	Page
LIFE SCIENCES	1890
Radiation Effects on Biochemicals	1890
Radiation Effects on Cells	1891
Radiation Effects on Microorganisms	1892
Radiation Effects on Plants	1894
Radiation Effects on Animals	1898
Man	1898
Vertebrates	1902
Invertebrates	1907
Radionuclide Effects (Internal Source)	1908
Man	1908
Animals	1910
Microorganisms	1910
Nuclide Kinetics and Toxicology	1910
Man	1910
Animals	1911
Plants	1911
New Tracer Techniques	1912
MATERIALS	1916
Ceramics and Cermets	1916
Metals and Alloys	1922
Corrosion and Erosion	1922
Preparation and Fabrication	1924
Properties, Structure, and Phase Studies	1927
Radiation Effects	1933
Other Materials	1934
NUCLEAR MATERIALS AND WASTE MANAGEMENT	1937
Accountability and Safeguards	1937
Disposal and Storage	1937
Handling Equipment and Procedures	1937
Transportation	1938
PARTICLE ACCELERATORS	1939
Design, Development, and Operation	1939
Auxiliaries and Components	1941
Ion Sources and Injection and Extraction Systems	1944
Ion Optics and Field Calculations	1945
Storage Rings	1946
Experimental Facilities	1946
PHYSICS (ASTROPHYSICS AND COSMOLOGY)	1948
Cosmic Radiation	1948
Stars	1950
Quasi-Stellar, Radio, and X-Ray Sources	1952
Solar Phenomena	1954
Galaxies	1955
Cosmology	1957
Planetary Phenomena	1958
PHYSICS (ATMOSPHERIC)	1959
Auroral and Ionospheric Phenomena	1959
Effects of Nuclear Detonations	1964
Magnetospheric Phenomena	1964

TABLE OF CONTENTS (continued)

Category	Page
PHYSICS (ATOMIC AND MOLECULAR)	1966
Beams and Their Reactions	1966
Atomic and Molecular Properties	1966
Positronium, Muonium, and Muonic and Mesic Atoms and Molecules	1968
Collision Phenomena	1968
Atomic Theory	1971
PHYSICS (ELECTROFLUID AND MAGNETOFLUID)	1973
PHYSICS (HIGH-ENERGY)	1974
Particle Interactions and Properties (Experimental)	1974
Electromagnetic	1974
Weak	1975
Strong (Baryon-induced)	1975
Strong (Meson-induced)	1977
Particle Interactions and Properties (Theoretical)	1978
General	1978
Electromagnetic	1980
Weak	1983
Strong (General)	1984
Strong (Baryon No. = 0)	1985
Strong (Baryon No. = 1)	1986
Strong (Baryon No. > 2)	1988
Particle Invariance Principles and Symmetries	1989
General	1989
Applications (Electromagnetic and Weak)	1989
Applications (Strong)	1989
Field Theories	1990
General	1990
Quantum Field Theory	1990
Gravitation and General Relativity	1991
Scattering Theory	1992
PHYSICS (LOW-TEMPERATURE)	1993
Superfluidity	1993
Superconductivity	1993
Equipment and Devices	1994
PHYSICS (NUCLEAR)	1996
Neutron Interactions with Matter	1996
Nuclear Properties and Reactions, $A < 5$	1999
Nuclear Properties and Reactions, $6 < A < 19$	2000
Nuclear Properties and Reactions, $20 < A < 38$	2002
Nuclear Properties and Reactions, $39 < A < 58$	2003
Nuclear Properties and Reactions, $59 < A < 89$	2006
Nuclear Properties and Reactions, $90 < A < 149$	2006
Nuclear Properties and Reactions, $150 < A < 189$	2009
Nuclear Properties and Reactions, $190 < A < 219$	2009
Nuclear Properties and Reactions, $A > 220$	2011
Nuclear Theory	2013
PHYSICS (PLASMA AND THERMONUCLEAR)	2021
Confinement and Heating	2021
Diagnostics	2025
Kinetics (General)	2025
Kinetics (Experimental)	2027
Kinetics (Theoretical)	2029

Category	Page
PHYSICS (PLASMA AND THERMONUCLEAR) (Cont'd)	
Production	2030
Stability	2031
Thermonuclear Engineering and Equipment	2034
Wave Phenomena	2035
PHYSICS (RADIATION AND SHIELDING)	2039
Radiation Physics	2039
Radiation Source Calibration and Standardization	2041
Shielding Calculations and Experiments	2042
PHYSICS (SOLID-STATE)	2043
Radiation Effects	2043
Physical Properties	2046
Moessbauer Effects and NMR	2049
PHYSICS (THEORETICAL)	2050
REACTOR TECHNOLOGY	2051
Power Reactor Development	2051
Physics and Core Engineering	2052
Control Elements, Systems, and Instrumentation	2053
Containment Systems, Shielding, Waste Processing and Radiation Protection	2054
Cooling Systems	2055
Fuel Systems and Components	2056
Auxiliary Systems, Protection Systems, and Engineered Safeguards	2057
Operation and Economics	2057
Safety and Siting	2057
Commercial Power Reactors	2059
Physics and Core Engineering	2059
Control Elements, Systems, and Instrumentation	2059
Cooling Systems	2059
Operation and Economics	2060
Safety and Siting	2063
Propulsion and Auxiliary Power Reactors	2067
Process Heat and Desalination Reactors	2069
Research and Test Reactors	2069
Reactor Components, Fuels, and Accessories	2073
Reactor Physics and Core Engineering	2074
Physics	2074
Core Thermal Hydraulics	2079
GENERAL	2081
Energy Economics	2081
Law	2081
Management	2081
Mathematics and Computers	2081
Miscellaneous	2082
CORPORATE AUTHOR INDEX	INDEX-1
PERSONAL AUTHOR INDEX	INDEX-11
SUBJECT INDEX	INDEX-72
REPORT NUMBER INDEX	INDEX-166

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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 19986 and 21470.

19422 (BLG-467, pp 8.1-19) SCIENTIFIC SUPPORT.

19423 (UCID-15644-72-3) ANALYTICAL CHEMISTRY QUARTERLY REPORT, JULY-SEPTEMBER 1972. Harrar, J. E. (comp.) (California Univ., Livermore. Lawrence Livermore Lab.). 5 Dec 1972. Contract W-7405-eng-48. 41p. Dep. NTIS.

Activation and Nuclear Reaction Procedures

19424 (AE-466) NEUTRON ACTIVATION OF LIQUID SAMPLES AT LOW TEMPERATURE IN REACTORS WITH REFERENCE TO NUCLEAR CHEMISTRY. Brune, D. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1972. 10p. Dep. NTIS. (U. S. Sales Only).

An activation procedure for liquid specimens is surveyed whereby the sample is refrigerated during neutron irradiation so that it is present in the solid state. Possible areas for application of the technique include: neutron activation determination of trace elements in water such as drinking and river and sea water and also that in biological tissues or fluids. Hot-atom chemistry applications include investigations relating to chemical effects arising from nuclear transformations. The interpretation of the hot chemical reactions may be facilitated in diluted frozen solutions. The technique can be applied to the preparation of radionuclides of high specific activity which are of interest in nuclear medicine. The technique may also be used for the determination of various constants such as thermal or epithermal neutron cross sections when high absorption or perturbation in the substances necessitates dilution. In this instance measurements may be facilitated by presenting the frozen diluted salt solutions for irradiation in the form of droplets. (auth)

19425 (CEA-CONF-2116) CAPABILITIES AND LIMITATIONS OF MULTIELEMENT NEUTRON ACTIVATION ANALYSIS OF BIOLOGICAL SAMPLES WITH OR WITHOUT SEPARATION OF THE ACTIVABLE MATRIX. Maziere, B.; Gaudry, A.; Stanilewicz, W.; Comar, D. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1972. 20p. (In French). (CONF-721010-26). Dep. NTIS. (U. S. Sales Only).

From International Conference on Modern Trends in Activation Analysis; Saclay, France (2 Oct 1972).

The performance and limiting sensitivity of a multielement instrumental analysis technique using a γ spectrometer equipped with a Ge(Li) detector were investigated for neutron-activated biological samples. The limiting sensitivities L_{Q10} and L_{Q100} were determined for 37 elements in blood serum and hepatic tissue. In order to improve the performance and to extend these limits, a rapid separation method for separating the principal elements (Na, P, K, and Zn) after irradiation was developed. (France)

19426 (CEA-CONF-2131) ANALYSIS OF TRACES THROUGH SIMULTANEOUS USE OF AN IONIC ABRADER AND NUCLEAR REACTION TECHNIQUES. Bruel, M.; Boissier, M.; Ligeon, E. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Oct 1972. 10p. (In French). (CONF-721010-22). Dep. NTIS (U. S. Sales Only).

From International Conference on Modern Trends in Activation Analysis; Saclay, France (2 Oct 1972).

A beam of low-energy ions is used in conjunction with a microanalytical apparatus for the direct observation of nuclear reactions. The system makes it possible to trace concentration profiles by abrasion counting. The results obtained concern: (a) the measurement of the impurity profile (boron, phosphorus) in silicon and ZnTe and (b) the study of the diffusion of oxygen under a neutron flux in niobium and nickel. (tr-auth)

19427 (CONF-721010-23) ANALYTICAL USE OF NEUTRON CAPTURE GAMMA RAYS. Henkelmann, R.; Born, H.-J. (Technische Universitaet, Munich (West Germany). Institut Fuer Radiochemie). 1972. 10p. Dep. NTIS (U.S. Sales Only).

From International Conference on Modern Trends in Activation Analysis; Saclay, France (2 Oct 1972).

Certain elements that cannot be detected with conventional neutron activation analysis can be determined using thermal neutron capture gamma analysis. The use of a curved neutron guide at the High Flux Reactor (Grenoble) with a thermal neutron flux of 1.5×10^{10}n/cm^{2}sec and the advantage of a low background counting system Ge(Li) detector, far away from the reactor core, are described. Experimental detection limits of a number of elements are given for the low energy and the high energy regions. Applications of the capture gamma method over the whole energy range are studied. (France)

19428 (CONF-721010-24) ROUTINE DETERMINATION OF BORON, CARBON, NITROGEN, AND OXYGEN BY CHARGED PARTICLES ACTIVATION ANALYSIS. Kuin, P. N.; Reynders, J. P. (Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands). Forschungslaboratorium). 1972. 9p. Dep. NTIS (U.S. Sales Only).

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Normalized parameters for the determination of boron, carbon, nitrogen, and oxygen are given. The irradiations are performed with 9-MeV protons or 7.5-MeV deuterons. The beam current is measured with a Faraday-cup; the beam current fluctuations are corrected with a computer calculation. The samples are automatically counted on a time schedule based upon the half-lives. Counting data are evaluated by means of computerized least square decay analysis. Absolute sensitivity factors having the following dimension: dpM ppM^{-1} μA^{-1}(g/cm^2)$^{-1}$ are determined. (France)

19429 (CONF-721010-31) CHARGED PARTICLE ACTIVATION ANALYSIS COUPLED WITH X-RAY COUNTING. McGinley, J. R.; Schweikert, E. A. (Texas Agricultural and Mechanical Univ., College Station). 1972. 8p.

From International Conference on Modern Trends in Activation Analysis; Saclay, France (2 Oct 1972).

A survey is given on the analytical use of x-ray emitting radioisotopes produced by charged particle activation. Thirty-nine proton and deuteron reactions were considered on seventy-six elements ($34 \leq Z \leq 82$). Thick target yields and sensitivity estimates are presented. The features and limitations of this method and the scope of nondestructive and destructive determinations are discussed. (auth)

19430 (CONF-721069-9) BIOLOGICAL MATRIX STANDARD REFERENCE MATERIALS FOR TRACE ELEMENT DETERMINATIONS. LaFleur, P. D. (National Bureau of Standards, Washington, D. C. Inst. for Materials Research). 1972. 8p.

From International colloquim on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

Two biological matrix Standard Reference Materials, SRM-1571, Orchard Leaves and SRM-1577, Bovine Liver, were issued by the United States National Bureau of Standards. The content of a number of trace elements was certified in these materials. The preparation and analytical program of the standards is described; these materials should be of great value in assuring quality control and in developing new procedures for analysis of biological materials. (France)

19431 (CONF-721069-12) ELEMENTAL ABUNDANCES OF LUNAR SOILS BY NEUTRON ACTIVATION ANALYSIS. Morrison, G. H.; Nadkarni, R. A. (Cornell Univ., Ithaca, N. Y. Dept. of Chemistry). 1972. 16p.

From International colloquium on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

Instrumental neutron activation analysis and neutron activation analysis using chemical group separations and high resolution gamma spectrometry were used to determine 42 elements in lunar samples. When used in conjunction with spark source mass spectrometry, more than 56 elements are determined with an average accuracy of 10%. A comparison is made of results of the analysis of lunar soils from Apollo 11, 12, 14, 15, and 16 and Luna 16. (France)

19432 (CONF-721069-18) ON THE APPLICATION OF CHARGED PARTICLE ACTIVATION ANALYSIS TO THE TRACE CHARACTERIZATION OF SEMICONDUCTOR MATERIALS. Schweikert, E. A.; McGinley, J. R.; Francis, G.; Swindle, D. L. (Texas Agricultural and Mechanical Univ., College Station. Activation Analysis Research Lab). 1972. 16p.

From International colloquium on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

The application of CPAA with delayed counting for the trace detection of oxygen, boron, and lithium is described. Proton, α, and ^{3}He activation were used for the nondestructive determination of oxygen in silicon with experimental detection limits of 0.06 and 0.05 ppM and 5 ppb, respectively. ^{3}He activation coupled with a post-irradiation radiochemical separation was applied for oxygen analyses in germanium with a detection limit of 10 ppB. Novel techniques were developed for boron and lithium based on the measurement of ^{8}Li ($t_{\frac{1}{2}}$: 850 msec) and ^{12}B ($t_{\frac{1}{2}}$: 20 msec) respectively, using a β coincidence technique with two thin plastic scintillators. The feasibility of this quasi-prompt approach is illustrated with results on silicon, germanium, and glass samples. (France)

19433 (EURISOTOP-74) ACTIVATION ANALYSIS WITH GAMMA PHOTONS AND CHARGED PARTICLES FOR THE DETERMINATION OF OXYGEN IN NON-FERROUS METALS, ESPECIALLY Al, Cu, Pb AND THEIR ALLOYS, Ti, Zr, Nb, Mo, Ta, Na, Cs, Si, Ge, AND Se. Engelmann, Ch. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). Oct 1972. 85p. (In French). Dep. NTIS (U.S. Sales Only).

The principle of activation analysis using charged particles and gamma photons and the various activation processes that can be used are reviewed. The intrinsically possible sensitivities of detection for various methods are given. The interferences that can arise from other elements are examined, and it is shown how they can be eliminated completely or minimized. The principle methods of chemical separation that are used to isolate the radioisotopes for measurement in the determination of oxygen are described. The various methods applicable to the determination of oxygen in general are reviewed, and then applications particularly to nonferrous metals are given. (tr-auth)

19434 (FRNC-CONF-69) APPLICATION OF PROTON ACTIVATION TO THE NONDESTRUCTIVE ANALYSIS OF Ag, Al, AND Co. Debrun, J. L.; Barrandon, J. N. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1972. 8p. (In French). (CONF-721069-5). Dep. NTIS (U.S. Sales Only).

From International colloquium on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

It is demonstrated that activation analysis with 11-MeV protons enables the nondestructive determination of traces of numerous elements in Ag, Al, and Co samples. In the case of Ag and Co, neutron activation analysis is difficult to perform. In the case of Al, protons enable elements, other than those determinable using neutron irradiation, to be determined. (France)

19435 (FRNC-CONF-70) DETERMINATION OF OXYGEN IN ALUMINUM. Vialatte, B. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1972. 11p. (In French). (CONF-721069-21). Dep. NTIS (U. S. Sales Only).

From International colloquium on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

Activation analysis with protons α and ^{3}He particles, and γ photons were used to determine oxygen in aluminum. It was thus possible to compare the results obtained with different particles. Analysis with ^{3}He particles appears to be the most satisfactory method. The oxygen content of aluminum is always very low no matter what is the degree of purity of the sample examined. (France)

19436 (FRNC-CONF-73) NEUTRON ACTIVATION ANALYSIS OF LANTHANIDES, Hf, Sc, Cr, Mn, Co, Cu, AND Zn IN MINERALS AND ROCKS. Treuil, M.; Jaffrezic, H.; Deschamps, N.; Derre, C.; Guichard, F.; Joron, J. L.; Pelletier, B.; Novotny, S. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1972. 17p. (In French). (CONF-721069-19). Dep. NTIS (U. S. Sales Only).

From International colloquium on the activation analysis of micro-quantities of elements in very high-purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

Rapid separation schemes are proposed that enable routine analysis of lanthanides, Hf, Sc, Cr, Mn, Co, Cu, and Zn to be effected for most minerals and rocks with an accuracy of between 3 and 10%. A large number of samples were analyzed using the method described and tests were carried out on standards. Examples are given, which demonstrate the usefulness of the method in systematic geochemical studies of transition elements. (France)

19437 (FRNC-CONF-76) SYSTEMATIC ANALYSIS OF Ce BY NEUTRON ACTIVATION. Rouchaud, J. C.; Revel, G. (Centre National de la Recherche Scientifique, Vitry (France)). 1972. 6p. (In French). (CONF-721069-17). Dep. NTIS (U. S. Sales Only).

From International colloquium on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

The irradiation of Ce with neutrons leads to high activity products. Chemical separation is indispensable. An ion exchange method applicable in tartric media was developed. Some twenty elements were determined in this way. The use of a Ge–Li junction detector enables such separations to be simplified. (France)

19438 (FRNC-CONF-78) NUCLEAR MICROANALYSIS USING MeV CARBON ION BACKSCATTERING; USEFULNESS AND APPLICATIONS. Abel, F.; Amsel, G.; Bruneaux, C.; Cohen, C.; Maurel, B.; Rigo, S.; Roussel, J. (Paris Univ., Orsay (France). Ecole Normale Superieure). 1972. 11p. (CONF-721010-21). Dep. NTIS (U. S. Sales Only).

From International Conference on Modern Trends in Activation Analysis; Saclay, France (2 Oct 1972).

The amplitude-energy relations and the corresponding energy resolutions were measured for ^{4}He and ^{12}C particles. It was found that the use of ^{12}C beams presents no marked advantage in increasing the mass or depth resolution. On the other hand, pile-up phenomena are drastically reduced by using ^{12}C backscattering. Applications in the determination of trace amounts of Sb or Yb near the surface of iron are presented. The contamination of silicon surfaces with Au can be accurately measured in a few minutes (values as low as 5×10^{11} gold atom/cm^2), the limiting sensitivity being of the order of 10^{10} at./cm^2 for traces of heavy elements e.g., Au, Hg, Pb, etc. Sensitivities for lighter elements are discussed. (auth)

19439 (JAERI-M-4900) NONDESTRUCTIVE NEUTRON ACTIVATION ANALYSIS FOR THE DETERMINATION OF MANY ELEMENTS IN A SAMPLE WITH A MONO-ELEMENT STANDARD. Okada, M.; Tamura, N. (Japan Atomic Energy Research Inst., Tokyo). Aug 1972. 29p. (In Japanese).

The procedure for identification and quantitative determination by gamma spectrometry and induced-activity calculation is described with a few examples. A sample is irradiated in a nuclear reactor together with the standard composed of one element. The two gamma activities induced are then compared, with a gamma spectrometer. NaI(Tl) is used as the scintillator if the irradiation is short, and if not, Ge(Li) is used. The thermal-neutron flux is estimated from the activity induced in the standard. The amounts of a number of elements in the sample are calculated from the respective photopeak areas; the cross sections for 2200-m/sec neutrons are utilized and influence by the epithermal neutrons is neglected. In this analysis, it is necessary that there is no interference by induced activity of the major component. The analysis of graphite is given as an example; 13 elements of 2 ppB to 10 ppM are thus determined. (auth)

19440 (NIM-1476) MAGNETIC-TAPE-ORIENTED SYSTEM FOR DATA REDUCTION IN NEUTRON-ACTIVATION ANALYSIS.

Watterson, L.; Watterson, J. I. W.; Rasmussen, S. E. (National Inst. for Metallurgy, Johannesburg (South Africa)). 20 Nov 1972. 28p. Dep. NTIS (U.S. Sales Only).

A system for use in the determination, by neutron-activation analysis, of the concentrations of elements present in large numbers of samples is described. The raw data from a multichannel analyser are recorded on computer-compatible magnetic tape or paper tape. The tape is processed by an extended version of the computer programme HEVESY. This version accepts data on magnetic tape and writes the output on a second magnetic tape. This second tape, together with calibration factors on punched cards, forms the data for a further programme, which provides the final values for the concentrations of the elements in the samples. The details for this suite of computer programmes are included. This system has resulted in considerable savings in the time required for the processing of data in multi-element activation analysis. Further development of the system is in progress. (auth)

19441 DETERMINATION OF 16 TRACE ELEMENTS IN HIGH-PURITY IRON BY NEUTRON ACTIVATION AND Ge(Li) γ SPECTROMETRY. Steinnes, E. (Institutt for Atomenergi, Kjeller, Norway). Scand. J. Met.; 1: No. 3, 137-139(1972).

After irradiation of pure iron with thermal neutrons the trace elements Al, As, Co, Cr, Cu, Ga, Hf, Mn, Mo, Sb, Sc, Ta, Ti, V, W, and Zn were determined by γ spectrometry. (auth)

19442 NEUTRON ACTIVATION ANALYSIS OF TRACE ELEMENT CONTENT IN SURGICALLY REMOVED SAMPLES OF THE HUMAN BRAIN. Schicha, H. (Kernforschungsanlage, Juelich, Ger.); Mueller, W.; Kasperek, K.; Schroeder, R. Beitr. Pathol.; 146: 366-374(Jul 1972). (In German).

In order to obtain normal values of trace element concentrations, 17 in vivo tissue samples from human brains, obtained by operation, were examined, including 8 samples from the cerebral cortex and 9 from the cerebral medulla. These data were compared with data from 48 samples from autopsy brain material. The trace elements Co, Fe, Rb, Se, Zn, Ag, Cr, Cs, Sb, and Sc were quantitatively measured by means of neutron activation analysis. The trace element content of Co, Sc, and Zn in the cerebral cortex was significantly higher than in the medulla. This may be caused by the presence of ganglion cells. The other elements showed no significant differences. The comparison of results of in vivo with autopsy samples showed a diminution of Rb and Co in the latter case. The reason for this reduction may be a postmortal diffusion, especially for Rb, which is biochemically similar to K. Trace element concentrations of human brain are lower than in other organs. (auth)

19443 CORRECTION OF SELF-ABSORPTION EFFECTS IN ACTIVATION ANALYSIS FOR OXYGEN WITH 14-MeV NEUTRONS. Leal Horta, J. A.; Dos Santos, A. N. (Instituto de Pesquisas Radioativas, Belo Horizonte, Brazil). Anal. Chim. Acta; 63: No. 2, 359-367(Feb 1973).

A method of correcting sample self-absorption effects in activation analysis for oxygen by 14-MeV neutrons is described. The effects of neutron, γ- and β-ray self-absorption are determined individually as a function of sample geometry and composition, by means of escape probabilities, and the overall correction factor is obtained by means of a computer code or through the use of tables. A procedure for measuring the β-contribution to the counts, which may amount to over 30%, is described. Results of analyses for samples of composition widely different from the standard are presented; these agree with stoichiometric values within 1%, although the correction may amount to more than 20%. (auth)

19444 DETERMINATION OF SILICON IN NATURAL AND POLLUTION AEROSOLS BY 14-MeV NEUTRON ACTIVATION ANALYSIS. van Grieken, R.; Dams, R. (Ghent Univ.). Anal. Chim. Acta; 63: No. 2, 369-381(Feb 1973).

The determination of silicon via the $^{28}Si(n,p)^{28}Al$ reaction by means of 14-MeV neutrons is applied to the analysis of pollution and natural aerosols. A Whatman 41 filter (40 cm^2) on which airborne particulate material has been collected is compressed into a 3 × 12.7 mm pellet. Standards are prepared in the same way from clean filters spiked with a silicate solution. After a 50-s irradiation and a 75-s decay time, the sample is counted for 2 min with 5″ × 5″ NaI(Tl) well detector. The 1.779-MeV photopeak of ^{28}Al is measured with a single channel scaler chain or with a multichannel analyzer. The reproducibility, sensitivity and liability to interference from other elements were investigated for both counting systems. The homogeneity of the pellets and the filters was checked. The overall precision of one single-channel determination was estimated to be 3.5% after a 24-h high-volume sampling time. Samples collected in urban, industrial and remote areas with concentrations ranging from 0.05 to 15 μg Si m^{-3} air were analyzed and the results are discussed. (auth)

19445 INSTRUMENTAL ACTIVATION ANALYSIS OF IRON AND IRON ORES WITH SHORT LIVED ISOTOPES AND ACCURATE DEAD-TIME CORRECTION. De Wispelaere, C.; Op de Beeck, J.; Hoste, J. (Univ., Ghent). Anal. Chem.; 45: No. 3, 547-552(Mar 1973).

A method is presented for an instrumental nondestructive determination of trace impurities in iron and iron ores by means of thermal neutron activation analysis using short-lived isotopes. A dead time correction method for the general case of a mixture of short and long lived isotopes is described. The elements Mo, Cu, Co, V, Ni, Al, and Mn were determined in high purity iron with concentrations of respectively 70, 40, 80, 2.5, 1000, 0.5, and 10 ppM. The elements V, Al, and Mn were determined in seven different ores. A digital PDP-9 computer was used for all data processing and interpretation. (auth)

19446 PRACTICAL EXPERIENCE IN THE NEUTRON ACTIVATION ANALYSIS OF WATERS. Schmitz, J.; Schneider, J.; Vogg, H. (Kernforschungszentrum, Karlsruhe, Ger.). Gas- Wasserfach, Wasser–Abwasser; 113: No. 7, 318-324(1972). (In German).

Based on the activation analysis by fast neutrons and reactor neutrons of natural waters from the region of the Danube and from the source of the Aach river, the possibilities and practical application of this method for the determination of trace elements and for tracer studies using activatable tracers (La) are described. (GF)

19447 SURFACE ANALYSIS BY MEANS OF NUCLEAR REACTIONS IN CORROSION RESEARCH. Herold, C.; Schubert, P.; Schulz, W. D. (Zentralstelle fuer Korrosionsschutz, Dresden). Isotopenpraxis; 8: No. 9, 321-327(Sep 1972). (In German).

An analytical method is described which renders possible quantitative determination of small quantities of oxygen on surfaces. This method is based on the nuclear reaction $^{18}O(p,\alpha)^{15}N$. The number of prompt alpha particles emitted during this reaction is a measure of the oxygen concentration of the investigated surface. The use of this method in corrosion research is considered. Oxygen contents of thin oxide layers (from 0.001 to 1 micron) on technologically interesting materials may be determined in accordance with the corrosion stress. The experimental details of the method are described. The equations needed for quantitative evaluation are derived, and the detection limit is estimated. Thermal nickel oxidation is shown as an example. (auth)

19448 GOLD AS AN ADDITIONAL TRACER OF REFRACTORIES IN THE SEARCH FOR SOURCES OF EXOGENIC INCLUSIONS IN STEEL. Jaskolska, H.; Michalik, J. (Inst. of Nuclear Research, Swierk, Poland). Isotopenpraxis; 8: No. 9, 333-336 (Sep 1972).

Refractory bricks labeled with lanthanum or gold were used to determine the origin and the quantity of exogenic inclusions in steel. After the melting process the steel samples were activated in the reactor and measured by means of a γ-ray spectrometer. Steel samples, labeled refractory bricks, as well as both gold and lanthanum solutions were activated to be used as reference samples. Performance and evaluation of the experiments are described. (auth)

19449 CRITICAL ESTIMATION OF THE ISOTOPIC METHOD USED FOR THE DETERMINATION OF THE ELECTRICAL EFFICIENCY OF THE ALUMINUM ELECTROLYSIS. Bazaniak, Z.; Michalik, J. (Inst. of Nuclear Research, Swierk, Poland). Isotopenpraxis; 8: No. 9, 337-340(Sep 1972). (In German).

The determination of the possibilities and accuracy measuring methods is of particular importance with regard to the technology of the aluminium process. Therefore, it was necessary to make use of a method which rendered possible checking of the technological effects caused by the modification of certain parameters of the manufacturing process. The isotopic method proved to be the most accurate and the fastest one. With 16 electrolytic cells a test series was performed to find out the method, either non-radioactive tracers or radioactive tracers, suitable for industrial application. Activation analysis proved to be the most suitable method to determine the electrical efficiency with minimum experimental expenditure. The basic problem involved in this approach was that of determining the practical possibilities of labeling the aluminium bath with a non-radioactive tracer. At present, similar experiments are being conducted making use of ^{110m}Ag and ^{198}Au. (auth)

19450 SIMPLE METHOD FOR THE ACTIVATION ANALYSIS OF MERCURY IN FISH: MERCURY CONTENT IN VENEZUELAN CANNED TUNA. Lukowitz, J. A.; Montoloy, F.; Heurtebise, M. (Instituto Venezolano de Investigaciones Cientificas, Caracas, Venezuela). pp 77-80 of Radiotracer Studies of Chemical Residues in Food and Agriculture. Vienna; International Atomic Energy Agency (1972).

From Radiotracer Studies of Chemical Residues in Food and Agriculture Meeting; Vienna, Austria (25 Oct 1971). See STI/PUB-332; CONF-711069-.

Irradiated samples are mineralized after a decay period of 2 to 3 days. The mineralized samples are passed through an anion exchange resin previously treated with a saturated solution of I_2/KI. The "iodinated" resin presents specific retention for Hg^{2+}. The resin column containing the ^{197}Hg is directly counted with a thin NaI(Tl) detector. The yield of the procedure is greater than 97%. The limit of detection was found to be 2.3 ng/g. Venezuelan and imported canned tuna were analyzed. Concentrations of 0.071 to 1.33 ppM were found. The method is rapid and presents a high decontamination factor. Up to 40 samples per day can be analyzed. (auth)

19451 PHOSPHORUS RESIDUES FROM ^{32}P-PHOSPHINE: AN ARTIFACT? Robinson, J. R. (Canada Dept. of Agriculture, London, Ontario). pp 89-91 of Radiotracer Studies of Chemical Residues in Food and Agriculture. Vienna; International Atomic Energy Agency (1972).

From Radiotracer Studies of Chemical Residues in Food and Agriculture Meeting; Vienna, Austria (25 Oct 1971). See STI/PUB-332; CONF-711069-.

Criticisms of earlier work with ^{32}P-labeled phosphine are discussed in the light of recent findings using neutron activation analysis following PHOSTOXIN treatment. (auth)

19452 INVESTIGATION OF METABOLIC BONE DISEASE. A New Approach by Partial Body Neutron Activation Analysis. Catto, G.R.D.; McIntosh, J.A.R.; MacLeod, M. (Univ. of Aberdeen, Scotland). Scot. Med. J.; 17: No. 11, 374(Nov 1972).

A method of detecting small changes in the calcium content of a hand by neutron activation analysis is described. Thermal neutron bombardment of the hand produces ^{49}Ca (a γ emitter with a half-life of 8.8 minutes) from the ^{48}Ca that is present as a small fixed percentage of naturally occurring calcium. By suitable bombardment and subsequent detection of the ^{49}Ca, a mean coefficient of variation of 5% was obtained. It was shown that activation analysis is a convenient and accurate indicator of early metabolic bone disease as the calcium is measured directly from a relatively large mass of bone in an area of the body known to be susceptible to demineralization. Successive analysis should provide quantitative information not only on the rate of progression of a demineralizing process but also on a response to therapy. (UK)

19453 RARE-EARTH ABUNDANCES IN THE ALKALINE VOLCANIC ROCKS FROM CAMPANIA, SOUTH ITALY. Capaldi, G. (Vesuvius Observatory, Naples); Gasparini, P.; Moauro, A.; Salvia, E.; Travaglione, O. Earth Planet. Sci. Lett.; 17: No. 1, 247-257(Dec 1972).

Eight rare earth elements (La, Ce, Sm, Eu, Tb, Dy, Yb, Lu) were determined by group separation neutron activation in the most typical members of the potash-rich Campania volcanic suite. The rare earth abundances are discussed in terms of the models proposed by several authors for the evolution of the single volcanoes and the origin of the potash-rich magmas. Although the rare earth data are not highly discriminative for some of the proposed models, nevertheless they indicate that it is quite unlikely that these magmas derive from differentiation processes involving continental or island-arc alkali basaltic parental magmas. The available data fit well a model involving high pressure partial melting of a continental crust in which a liquid in equilibrium with a pyroxene–garnet solid assemblage is formed. (auth)

19454 CONTINUOUS NEUTRON ACTIVATION ANALYSIS OF FLOWING SOLUTIONS. IV. Silver and Vanadium Determination. Kliment, V.; Toelgyessy, J. (Technical Univ., Bratislava). Isotopenpraxis; 8: No. 6, 211-214(Jun 1972). (In German).

Silver and vanadium were determined by continuous neutron activation analysis in aqueous solutions. Silver was determined making use of the nuclear reactions $^{109}Ag(n,\gamma)^{110}Ag$ and $^{107}Ag(n,\gamma)^{108}Ag$, while for vanadium use was made of the nuclear reaction $^{51}V(n,\gamma)^{52}V$. The accuracy was 0.3 mg ml^{-1} for silver determination and 0.4 mg ml^{-1} for vanadium determination. It was determined by the statistical error of radioactivity measurement only. (auth)

19455 SOME POSSIBILITIES OF IMPROVING THE SELECTIVITY OF BETA IRRADIATION COUNT IN ACTIVATION ANALYSIS. Gordadze, G. P.; Soseliya, A. A.; Megrelishvili, K. Ya.; Bakhtadze, L. B.; Nadibaidze, A. G. (Inst. of Physics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 69: No. 1, 49-52(Jan 1973). (In Russian).

A technique is described for the selective counting of beta irradiation in activation analysis using the optimal beta detector and measuring circuit. It enables analysis of complex beta spectra and isolation of beta rays of the sought energy. The developed technique considerably widens the possibility of beta count use in activation analysis. (auth)

19456 USE OF THE NEUTRON HOWITZER FOR BORON DETERMINATION IN GLASS. Knorr, J.; Jugelt, P.; Krause, A. (Technische Univ., Dresden). Isotopenpraxis; 8: No. 8, 306-309 (Aug 1972). (In German).

The prompt radiation originating with the reaction $^{10}B(n,\alpha)^{7}Li$ and having an energy E_γ = 478 keV is the basis of the nondestructive quantitative determination of boron in glass. An irradiation unit, called "neutron howitzer", furnished with a 5 Ci $^{241}AmBe$ neutron source is described. With B_2O_3 concentration ranging from 5 to 25% in mass and holding time being 10 min, it provides relative error of analysis being less than 2%. (auth)

19457 TRACE-ELEMENT VARIATION OF INDIVIDUAL PLAGIOCLASE AND HORNBLENDE PHENOCRYSTS. Osborn, T. W.; Dudas, M. J.; Schmitt, R. A. (Univ. of California, San Diego). Chem. Geol.; 10: No. 3, 205-210(Nov 1972).

High-flux instrumental neutron activation analysis was used to evaluate trace element variation in individual plagioclase and individual hornblende crystals. For plagioclase crystals coefficients of variation for elemental abundances ranged from 4.9 to 11.1% for Fe, Ba, La, Sm, and Eu while the major element Na exhibited a coefficient of variation of 2.5%. For a carefully selected group of hornblende crystals, coefficients of variation were 6, 10, and 11% for Fe, Sc, and Co, respectively. The rare-earth elements and Cr displayed coefficients of variation ranging from 56 to 105% for the hornblende crystals. Correlation coefficients between (1) individual phenocryst masses and trace element contents of the phenocrysts, and (2) between elements were calculated. Several possible causes for the observed trace-element variation are suggested. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 19905 and 20332.

19458 (AERE-R-6966) RAPID EMISSION SPECTROGRAPHIC METHOD FOR THE ANALYSIS OF AIR FILTERS. Webb, R. J.; Webb, M. S. W. (Atomic Energy Research Establishment, Harwell (England)). Jan 1972. 7p. Dep. NTIS (U.S. Sales Only). UK 50 pence.

A rapid spectrographic method for direct excitation of small portions of air filters is described. Limits of detection between 0.1 and 1 μg are obtained for cadmium, lead, copper, nickel, manganese, iron, magnesium, vanadium, and boron. (auth)

19459 (ARH-SA-146) FACILITY FOR ANALYSIS OF INTENSELY RADIOACTIVE SAMPLES BY ATOMIC ABSORPTION. Harnly, J. M. (Atlantic Richfield Hanford Co., Richland, Wash). [nd]. Contract AT(45-1)-2130. 4p. (CONF-730305-1). Dep. NTIS.

From National Society Meeting; Dallas, Texas, United States of America (USA) (Mar 1973).

Atomic absorption technique is used to continuously monitor the processes for the separation of ^{90}Sr and ^{137}Cs from radioactive wastes, to characterize the separated ^{90}Sr solution, and to characterize the purified ^{90}Sr product. In addition, atomic absorption is also used to characterize ^{241}Am product, separated from plutonium wastes, and to provide analytical support for plant Research and Development, whose charter is to develop a satisfactory process for the immobilization of nuclear waste materials. The work load from all sources consists of samples containing all forms of radioactivity, alpha, beta, and gamma. The radioactivity levels of individual samples may range from negligible, up to 100 Ci/l for ^{90}Sr, 100 Ci/l for ^{137}Cs, and 0.1 Ci/l for ^{241}Am. (DHM)

19460 (HEDL-SA-392) SPARK SOURCE MASS SPECTROGRAPHIC ANALYSIS OF PLUTONIUM-URANIUM OXIDES. Ko, R. (Hanford Engineering Development Lab., Richland, Wash.). [nd]. 9p. (CONF-720628-5). Dep. NTIS.

From 27th ACS Northwest Regional Meeting; Corvallis, Oregon, United States of America (USA) (15 Jun 1972).

Spark source mass spectrography was applied to the determination of difficultly analyzed impurities such as tantalum, tungsten, and the rare earth elements in uranium oxide and in plutonium-uranium mixed oxides. Concentrations were estimated from the least exposure producing a just visible line. By increasing the exposure, fractional parts per million may be detected. (ERB)

19461 (HEDL-SA-395) DIRECT ISOTOPIC ANALYSIS OF BORON IN BORON CARBIDE. Goheen, M. W. (Hanford Engineering Development Lab., Richland, Wash). [nd]. 11p. (CONF-720628-4). Dep. NTIS.

From 27th ACS Northwest Regional Meeting; Corvallis, Oregon, United States of America (USA) (15 Jun 1972).

The sodium carbonate on-filament fusion technique is rapid, requiring only ten minutes or so for one complete analysis and was shown to be precise and not subject to contamination. Further, extremely small, tiny dust-speck size samples, as well as large samples, can be analyzed successfully. This allows doing nuclear burn-up profiles across single boron carbide pellets. (auth)

19462 (NIM–1467) SPECTRAL ANALYSIS OF SOLUTIONS. I. THE ANALYSIS OF RARE-EARTH MINERALS. Watson, A. E.; Russell, G. M. (National Inst. for Metallurgy, Johannesburg (South Africa)). 31 Oct 1972. 17p. Dep. NTIS. (U. S. Sales Only).

A technique is described for the spectrochemical determination of the individual rare earth elements in rare earth minerals after they have been fused, leached, and dissolved. The sample is fused with potassium bifluoride and leached with hydrofluoric acid solution, in which the rare earth group, thorium, calcium, and uranium(IV) are insoluble. The residue is dissolved in a mixture of nitric and perchloric acids, fumed for the removal of excess perchloric acid, and finally dissolved in hydrochloric acid. Calcium is separated from the rare earths by ammonia, and the precipitate is dissolved in hydrochloric acid. Hafnium (internal standard), lithium metaborate (buffer), and a miscible solvent consisting of ethylene glycol and acetone are added, and the mixture is made up to volume. This solution is excited by a plasma-jet source, and the spectra are recorded photographically. The results of typical analyses are given, together with precision data. The performance of the plasma jet is compared with that of the rotating disc on the same solutions. The range of concentration covered is between 3% and 50% of total rare earth oxides. (auth)

19463 (UCRL-Trans-10657) DOUBLE-CELL COULOMETRIC DETERMINATION OF ALKALI AND ALKALI-EARTH METALS. Muto, G.; Nonako, T.; Nozaki, K. Translated from Jap. Anal.; 20: No. 2, 180-187(1971). 19p. Dep. NTIS.

Lithium, sodium, potassium, strontium, and barium were determined by double-cell coulometry. A new type of double-cell was used, in which the electrolyte is separated into upper and lower cells by a mercury layer supported on a cation exchange membrane. The sample was deposited over the upper surface of the mercury layer to form an amalgam and eluted into the lower cell. The coulometric measurement was carried out by integrating the dissolution current of the amalgam under a controlled potential. (auth)

19464 STUDIES ON THE ANALYTICAL CHEMISTRY OF HAFNIUM AND ZIRCONIUM. Pt. 3 Spectrofluorimetric Determination of Hafnium in the Presence of Zirconium by Using Quercetin. Kouimtzis, T.; Townshend, A. (Univ. of Birmingham, Eng.). Analyst; 98: No. 1162, 40-41(Jan 1973).

Hafnium at concentrations of 0.2% m/m and above in hafnium–zirconium mixtures can be determined spectrofluorimetrically via its complex with quercetin in 55% perchloric acid. There is no interference from zirconium. (auth)

19465 COMPLEXOMETRIC DETERMINATION OF PRASEODYMIUM. Thakur, R. D.; Sahay, J. N. (Univ. of Bihar, India). Z. Phys. Chem. (Leipzig); 250: No. 5-6, 396-398(1972).

Praseodymium was determined titrimetrically by dissolving the precipitate, obtained on boiling praseodymium sulfate and sodium rhodizonate together, in dilute sulfuric acid and titrating against a standard ceric sulfate solution using N-phenylanthranilic acid as indicator. The maximum error was 0.4%. The range in which praseodymium was determined varied from 9.4765×10^{-4} to 37.7838×10^{-4} g. Interferences by certain metal ions were observed. (auth)

19466 NEW SPOT TEST FOR THE IDENTIFICATION OF URANIUM IN MINERALS. Goldstein, D.; Libergott, E. K. (Univ. Federal Fluminense, Rio de Janeiro). Anal. Chim. Acta; 63: No. 2, 491-492(Feb 1973).

A spot test is described that has the advantage of being specific for uranium in the presence of EDTA. It allows a simple, sensitive, and rapid detection in minerals even in field conditions. The reagent is a Schiff's base prepared by the condensation of 1-hydroxynaphthaldehyde and 2-aminopyrimidine. It produces with uranyl ions a blood red precipitate which can be extracted with carbon tetrachloride. A positive response is obtained with samples containing 0.01% uranium. (DHM)

19467 DETERMINATION OF NITROGEN IN URANIUM. Establishment of a reference standard. Fest, J. C. (CEN de Valduc, Is-sur-Tille, France); Schott, R. Anal. Chim. Acta; 63: No. 2, 383-391(Feb 1973). (In French).

Traces of nitrogen can be determined in uranium by reductive fusion in vacuum or in a current of helium. The two methods gave similar results, and these were confirmed by the Kjeldahl method. The excellent agreement between the values obtained made it possible to establish a reference standard. (auth)

19468 SPECTROPHOTOMETRIC DETERMINATION OF P.P.B. LEVELS OF LONG-CHAIN AMINES IN WATERS AND RAFFINATES. Florence, T. M.; Farrar, Y. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Anal. Chim. Acta; 63: No. 2, 255-261(Feb 1973).

An analytical procedure is described for the determination of ppB levels of long-chain amines in river and sea water and uranium processing raffinates. The method involves extraction of the amine as an ion-association complex with chromate from sulfuric acid media into chloroform. The extracted chromium(VI) is then determined spectrophotometrically with diphenylcarbazide. With a 100-ml sample, the limit of detection for Alamine 336 (a commercial tertiary amine mixture) is 15 ppB. (auth)

19469 DETERMINATION OF CADMIUM IN URANIUM AND THORIUM COMPOUNDS BY ATOMIC FLUORESCENCE SPECTROMETRY. Murugaiyan, P.; Natarajan, S.; Venkateswarlu, C. (Bhabha Atomic Research Centre, Bombay). Anal. Chim. Acta; 64: No. 1, 132-134(Mar 1973).

An atomic fluorescence spectrometric method for determining cadmium in uranium and thorium compounds at sub-ppM level is described. The standard deviation for the determination of Cd at 0.06 ppM level was 7%. (DHM)

19470 REVERSED-PHASE FOAM CHROMATOGRAPHY. Redox reactions on open-cell polyurethane foam columns supporting tetrachlorohydroquinone. Braun, T.; Farag, A. B.; Klimes-Szmik, A. (Lorand Eoetvoes Univ., Budapest). Anal. Chim. Acta; 64: No. 1, 71-76(Mar 1973).

The use of elastic polyurethane foam as a support for chloranil was proved successful. Reductions of cerium(IV), vanadium(V), and iron(II) on foam-filled columns were carried out quantitatively and rapidly. The effect of flow-rate and temperature on the reduction of each metal ion was examined in detail. Cerium(IV) was reduced quantitatively on passing through the foam-redox column at flow-rates of 2 to 11 ml min^{-1} at room temperature. The reduction of vanadium(V) and iron(III) was slower; complete reduction occurred only at flow-rates up to 4 and 2 ml min^{-1} for V(V) and Fe(III), respectively. At 35°C, however, it was possible to use flow-rates of 7 and 6 ml min^{-1} for the quantitative reduction of V(V) and Fe(III), respectively. (auth)

19471 DETERMINATION OF PHOSPHORUS AND MOLYBDENUM IN HIGH-CHROMIUM AND HIGH-TUNGSTEN STEELS. Potsebneva, N. G.; Butorina, T. K. Tr. Vses. Nauch.-Issled. Inst. Stand. Obraztsov Spektr. Etalonov; 6: 117-121 (1970). (In Russian).

P is determined photometrically, as reduced molybdophosphate, after oxidation of the Cr with $HClO_4$ and its removal by distillation as CrO_2Cl_2. The method is applicable to steels containing >10% of W and ≈4% of Cr. For determination of Mo in the presence of W, photometric measurement of the $Mo-SCN^-$ complex is used; W is masked with citric acid and the Mo^{VI} is reduced to Mo^{V} with $SnCl_2$. (Referativnyi Zh.)

19472 USE OF ATOMIC ABSORPTION FOR MONITORING THE COMPOSITION OF GLASS. Sedykh, E. M. Steklo Keram.; No. 4, 46-47 (1971). (In Russian).

The method was devised for determining from 1 to 30% each of Ti, Al, Pb, Zn, Ba, Sr, Mg, and Ca and from 0.001 to 1% each of Fe, Co, Ni, Ag, and Sb. For Al and Ti, a N_2O–acetylene flame is necessary, but the other elements can be determined with an air–acetylene flame. In the determination of Al, standards must contain K and Na in amounts corresponding to those present in the sample. In determining Ca, Mg, Ba, and Sr, the matrix effect is eliminated by addition of La. The preparation of the sample consists in dissolving the glass in a mixture of HF with $HClO_4$ or HNO_3. (Referativnyi Zh.)

19473 INFLUENCE OF ORGANIC SOLVENTS AND IONIZATION INHIBITORS IN THE DETERMINATION OF LANTHANUM BY ATOMIC ABSORPTION SPECTROPHOTOMETRY. Aliotta, C.; Reale, C. A. (Univ. Nacional del Sur, Bahia Blanca, Argentina). An. Asoc. Quim. Argent.; 59: No. 6, 399-403(1971). (In Spanish).

In the presence of methanol, ethanol, or propanol, the absorption of dilute HCl solutions of La in an acetylene–N_2O flame increased with increasing proportion of organic solvent (20 to 80%); it also increased with butanol (90%). In the presence of acetone or glycerol (20 to 80%), absorption decreased with the proportion of solvent. Addition of KCl (0.2M) or LiCl (0.3M) as ionization inhibitor increased the absorption. There was no correlation between absorption and aspiration rate, as the addition of alcohols or of acetone increased the latter. (Anal. Abstr.)

19474 DETERMINATION OF IODINE IN PLANTS AND IN ANIMAL FEEDSTUFFS. Fioravanti, P.; Halmi, M. (Station Federale de Recherches Agronomiques, Liebefeld, Switzerland). Mitt. Geb. Lebensmittelunters. Hyg.; 62: No. 4, 388-397(1971). (In French).

To avoid loss of iodine by volatilization, samples were mineralized by treatment with N-KOH-10% aqueous $ZnSO_4$ (2:1) and subsequent ignition at 450°. The residual ash was extracted with H_2O, then centrifuged. The I^- were then determined in the supernatant liquid by a method based on the catalytic action of I^- on the redox reaction between Ce^{IV} and As^{III} (Paletta, Analyt. Abstr., 1970, 19, 3031) modified by the addition of Fe^{II}, and colorimetric determination of the Fe^{III} so formed with sulphosalicylic acid. The coefficient of variation for iodine contents of 0.3 to 4 p.p.m. was <5%. (Anal. Abstr.)

19475 PHOTOMETRIC DETERMINATION OF THORIUM IN SOIL. Zhukov, B. I. Pochvovedenie; No. 2, 156-158(1971). (In Russian).

After extraction of Th from the sample by fusion with Na_2O_2 and leaching with H_2O, the Th is co-precipitated on Ca oxalate for subsequent photometric determination with arsenazo III. The sensitivity is 0.04 μg of Th per ml of final solution and the error is ±6%. (Referativnyi Zh.)

19476 USE OF CHROMATOGRAPHIC SEPARATION IN DETERMINATION OF CERIUM IN HIGH-TEMPERATURE ALLOYS. Fedorova, N. D.; Fokina, L. S.; Makarov, M. K. Tr. Vses. Nauch. Issled. Inst. Stand. Obraztsov Spektr. Etalonov; No. 6, 98-104 (1970). (In Russian).

Dissolve 0.1 to 0.3 g of sample in 30 ml of aqua regia, evaporate to a moist residue, add 5 to 10 ml of HNO_3, and again evaporate; repeat this treatment two or three times. Dissolve the final residue, with heating, in 10 ml of 10N-HNO_3, then add 0.1 g of $KBrO_3$, 15 ml of 10N-HNO_3, and 1 g of $KBrO_3$, and pass the solution (at 1 ml per min.) through a column (10 cm × 1 cm) of anion-exchange resin AV-20E that has been washed with 100 ml of 10N-HNO_3 made 0.06N in $KBrO_3$. Wash the column with 150 ml of the solution used to wash the resin, then elute Ce with 150 ml of 3N-HNO_3 containing N_2H_4. Evaporate the eluate to small volume, evaporate this solution two or three times each with HNO_3 and HCl, and dissolve the residue in HCl plus a little aqueous H_2O_2; evaporate to small volume, then dilute to 50 ml. Evaporate 25 ml of this solution to small volume, add 1 ml of 0.5% ascorbic acid solution and 10 ml of 20% sulphosalicylic acid solution, adjust the pH to 2 with 50% Na acetate solution, add 20 to 25 ml of buffer solution of pH 2 and 3.5 ml of a 0.1% arsenazo III solution, dilute to 50 ml with the buffer solution, and measure the extinction at 655 nm. (Referativnyi Zh.)

19477 DETERMINATION OF TRACES OF CHLORINE, SULFUR, SELENIUM, AND TELLURIUM IN PURE METALLIC BISMUTH. Ustimov, A. M.; Chalkov, N. Ya. Russian Patent 336,595. 21 Apr 1972. Filed date 21 Jul 1970. vpp. (In Russian).

Trace amounts of Cl, S, Se, and Te were determined in pure metallic Bi after separation with simultaneous concentration. To increase the sensitivity of detection, the trace elements were extracted from molten Bi at 320 to 50° with NaOH and metallic Na at concentrations of 0.2 to 2.5% and 0.1 to 1% by weight of Bi, respectively. (Selenium-Tellurium Abstr.)

19478 OXIDATION OF CERIUM(III) AND ITS AMPEROMETRIC DETERMINATION. Bogovina, V. I.; Usatenko, Yu. I.; Novak, V. P.; Mal'tsev, V. F. Tr. Vses. Nauch.-Issled. Inst. Stand. Obraztsov Spektr. Etalonov; 6: 124-130(1970). (In Russian).

It is shown that Mn(III) or MnO_4^- can be used for oxidizing Ce(III) in 15N to 25N H_2SO_4 medium. To determination of 0.05 to 5% of Ce in cast iron, steel, or alloys, dissolve 0.3 g of sample in aqua regia, evaporate the solution to fumes with H_2SO_4, adjust the H_2SO_4 concentration to 18N, cool the solution to 20°, and oxidize the Ce with 0.1N $KMnO_4$ or $Mn_2(SO_4)_3$. Decompose excess of oxidant with 4% $NaNO_2$ solution, after 30 sec. add rapidly 5 ml of 30% urea solution, and titrate the Ce(IV) with 1.25 to 2.5 mM $(NH_4)_2SO_4$-$FeSO_4$ at 0.9 V, with use of a platinum electrode. For sequential determination of Ce and V (molecular ratio 1:10 to 10:1), oxidize the Ce and V and decompose excess oxidant as before, add urea, and titrate the Ce and V in 2N H_2SO_4 medium as basal electrolyte, with use of two platinum electrodes at 0.7 V or a rotating platinum electrode at 0.75 V (vs. the S.C.E.). With complex mixtures, precipitate the Ce as CeF_3 at pH 2.8 to 3.0 in the presence of EDTA and of La or Al as carrier, calcine the residue at 850°, dissolve it in H_2SO_4, add aqueous H_2O_2, boil, and proceed as described above. Nickel, Al, Cr, Te, Mo, Nb, Ti, Mn, rare-earth metals, $P_2O_7^{4-}$, and PO_4^{3-} do not interfere, but Cl^- does. (Referativnyi Zh.)

19479 FLAME SPECTROPHOTOMETRIC DETERMINATION OF MICROCONTENTS OF LITHIUM, RUBIDIUM, AND CESIUM IN MINERAL AND ROCKS FROM THE LESS ONE MILLIGRAM WEIGHT. Shapkina, Yu. S.; Prudnikov, E. D. Vestn. Leningrad. Univ., No. 18, Geol., Geogr.; No. 3, 116-117(Sep 1972). (In Russian).

A method for the flame spectrophotometric determination of micro amounts of lithium, rubidium, and cesium in minerals and rocks from microsamples of the less one milligram weight by pulse evaporation of material in the air-acetylene flame from a microprobe is described. (auth)

19480 GRAVIMETRIC DETERMINATION OF ZIRCONIUM IN ZIRCONIUM CONCENTRATES AND SILICO-ZIRCONIUM WITH MANDELIC ACID AS REAGENT. Silaeva, E. V.; Barbash, T. L.; Pyrina, M. P. Tr. Vses. Nauch.-Issled. Inst. Stand. Obraztsov Spektr. Etalonov; 6: 113-117(1970). (In Russian).

The concentrate sample (0.1 g) is decomposed by a conventional fusion with $Na_2B_4O_7$-Na_2CO_3 (2:1) at 1000°C, and the final solution is prepared in 4N HCl. This solution is heated to 80°, then treated with 15% mandelic acid solution and set aside overnight. The precipitated Zr mandelate is collected, washed, ignited at ≈1100° and weighed as ZrO_2. For "silico-zirconium," the sample is decomposed with H_2SO_4-HF-HNO_3, the solution is evaporated to expel H_2SO_4, the residue is diluted with HCl, and the Zr is precipitated as described above. (Referativnyi Zh.)

19481 DETERMINATION OF ^{18}O CONTENT OF PHOSPHATE COMPOUNDS: NOVEL METHOD. Bar-Tana, J.; Ben-Zeev, O.; Rose, G.; Deutsh, J. (Hebrew Univ., Jerusalem). Biochim. Biophys. Acta; 264: No. 1, 214-219(1972).

It is shown that trimethylsilyl derivatives of phosphates are suitable for direct examination by mass spectroscopy, and details are given for preparing these derivatives of H_3PO_4 and of AMP by treatment with bis(trimethylsilyl)acetamide in acetonitrile medium. Such derivatives have been used in studying the enzyme-catalyzed hydrolysis of ATP by $H_2{}^{18}O$ and the transfer of ^{18}O from [carboxy-^{18}O]acetic acid to AMP. The mass spectra of the derivatives are discussed, and the advantages of the procedure over the more usual method (in which the phosphate-O is converted into CO_2 or O_2 for analysis by mass spectroscopy) are cited. (Anal. Abstr.)

19482 OXIDATIVE DETERMINATION OF NIOBIUM. Rakhmatulin, Ya. Tr. Inst. Khim. Nauk, Akad. Nauk Kaz. SSR; 32: 73-77(1971). (In Russian).

The method involves reduction of Nb(V) by zinc or cadmium amalgam in H_2SO_4, H_3PO_4, or $H_4P_2O_7$ and oxidation of the resulting Nb(IV) with $KMnO_4$ or $FeCl_3$ solution. Optimum conditions were established for use with the various acid media. There is no interference from Ta when the ratio of Ta to Nb is 0.5 (in H_2SO_4 or H_3PO_4 medium) or from Zr at a ratio of Zr to Nb of 7 (in H_2SO_4 medium). (Referativnyi Zh.)

19483 CHEMICAL ANALYSIS OF SILICON-CERIUM ALLOYS. Engel, O.; Kral, S. (SONP, Kladno, Czech.). Hutn. Listy; 26: No. 11, 830-832(1971). (In Czech).

Procedures are given for the determination of S (iodimetrically), P (spectrophotometrically with molybdate reagent), Si (9 to 45%, gravimetrically), Al (complexometrically), Fe (complexometrically), and Ce [2 to 42%, gravimetrically as CeO_2 after precipitation with NH_4F, or titrimetrically with $FeSO_4$ solution after oxidation of Ce(III) with $(NH_4)_2S_2O_8$]. Carbon was determined by combustion in a stream of O. (Anal. Abstr.)

19484 COLOR REACTION OF CHLOROPHOSPHONAZO III WITH RARE EARTH METALS. Lukin, A. M.; Luk'yanov, V. F.; Nikol'skaya, I. V.; Chernysheva, T. V. Tr. Vses. Nauch.-Issled. Inst. Khim. Reaktivov; No. 32, 7-13(1970). (In Russian).

The absorption spectra of solutions of complexes of chlorphosphonazo III (I) with individual rare-earth metals in HCl medium were studied. Elements of the Ce subgroup react with I with significantly better sensitivity than do elements of the Y subgroup [the detection limit for La, Nd, or Er is 4 to 5 μg in 50 ml of solution, and the molecular extinction coefficient (at 680 nm) for the complex of I with Nd is ≈40,000]. In 0.2N-HCl medium, 1:1 complexes are formed, the color stability depending on the atomic number of the element. At HCl concentration from 0.2N to N, the extinction of the Nd complex changes insignificantly. Addition of oxalic acid increases the selectivity of the reaction. With a 2-fold molecular excess of I, in 0.2N HCl, Beer's law is obeyed with 10 to 60 μg of rare earth metal in 50 ml of solution. To the neutral test solution add 10 ml of N HCl, 10 ml of 8% oxalic acid and 4 ml of 0.25 mM I, dilute the solution to 50 ml, and measure the extinction at 680 nm. A 1000-fold excess of Zn, Al, or Sn, a 500-fold

excess of Hf, Zr, Nb, Ta, or W, a 200-fold excess of Fe (in the presence of 1 ml of 1% aqueous ascorbic acid), a 100-fold excess of Ti, a 50-fold excess of Be or Pb, a 20-fold excess of Ca, a 10-fold excess of Sc, a 4000-fold excess of PO_4^{3-}, or a 30,000-fold excess of SO_4^{2-} do not affect the determination of 10 μg of La. (Referativnyi Zh.)

19485 ANALYTICAL USE OF THE PRECIPITATION OF OXALATES OF ALKALINE EARTH METALS IN ISOPROPYL ALCOHOL MEDIUM. Bork, V. A.; Shvyrkova, L. A.; Kuznetsov, V. V. Tr. Mosk. Khim.-Tekhnol. Inst.; No. 67, 160-163(1970). (In Russian).

A study is presented of the biamperometric titration, with oxalic acid solution, of cations of these elements in isopropyl alcohol; copper indicator-electrodes are used. The shapes of the titration curves are discussed, and it is shown that the solubilities of the oxalates in 30% isopropyl alcohol increase in the order Sr, Mg, Ba, Ca. The technique can be used to analyze binary mixtures of Ca with Sr or Mg, or of Ba with Sr, but not mixtures of Ba with Ca. The error for each element in a binary mixture is ≃1%. (Referativnyi Zh.)

19486 CATHODE-RAY-EXCITED EMISSION SPECTROMETRY OF TRACE RARE EARTHS IN YTTRIUM OXIDE VIA YTTRIUM OXYSULFIDE CONVERSION. Larach, Simon; Shrader, R. E. (RCA Labs., Princeton, NJ). Anal. Chim. Acta; 63: No. 2, 459-463(Feb 1973).

A method for determining trace rare earths in yttrium oxide by cathode-ray excited emission spectrometry is presented in which the sensitivity for praseodymium, europium, and terbium can be improved by conversion of yttrium oxide to yttrium oxysulfide. It was concluded that in order to carry out a complete analysis for trace rare earths with maximum sensitivity a part of the sample should be converted to yttrium oxysulfide and the luminescence of both matrices should be examined carefully. (DHM)

19487 X-RAY EXCITED OPTICAL FLUORESCENCE OF TRACE RARE EARTHS IN YTTRIUM PHOSPHATE AND YTTRIUM VANADATE HOSTS. The Part per Giga Level Determination of Rare Earth Impurities in Yttrium Oxide. D'Silva, A. P.; Fassel, V. A. (Ames Lab., Iowa). Anal. Chem.; 45: No. 3, 542-547(Mar 1973).

Yttrium oxide is a common starting material for the preparation of various solid-state luminescent materials. Since the luminescent efficiency of these materials may be adversely affected by the presence of ultratrace rare earth impurities, there has existed a pressing need for an analytical technique capable of assessing the purity of Y_2O_3. A comparative evaluation of the x-ray excited optical fluorescence spectra of various yttrium-containing compounds has revealed that YPO_4 and isostructural YVO_4 are superior hosts for the ultratrace determination of the Ce to Yb series of impurities occurring at the part per giga (1 in 10^9) level in highly purified Y_2O_3. (auth)

19488 LASER EMISSION SPECTROGRAPHY OF RARE EARTH ELEMENTS. Ishizuka, T. (Government Industrial Research Inst., Nagoya, Japan). Anal. Chem.; 45: No. 3, 538-541(Mar 1973).

Emission spectrography of rare earth elements in several matrixes is studied by using a Q-switched ruby laser as an exciting source for macro analysis. The emission intensities of rare earth elements are considerably affected by the matrixes of the samples. The emission intensities of rare earth elements are most intense in a sodium chloride matrix, but fairly suppressed in a sodium sulfate matrix. Scandium, yttrium, europium, and ytterbium in a sodium chloride matrix are detected down to concentrations of ppM order with one laser shot. The emission intensities of rare earth elements in refractory oxides, such as aluminum oxide rare earth oxides, are about two orders of magnitude less than those in a sodium chloride matrix. (auth)

19489 APPLICATION OF A STATISTICAL METHOD TO ISOTOPIC ANALYSIS. General Principles. Genty, C. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). Anal. Chem.; 45: No. 3, 505-511(Mar 1973).

The statistical theory was applied to the analysis of a mixture of isotopic compounds of a same species. Simple molecules like XA_n and more complex molecules like $XA_m-YA_{m'}-ZA_{m''}$ and $XA_m-YA_{m'}-XA_m$ in which the atom A can be randomly chosen among p isotopes are studied. In each case, the number of isotopic compositions for a given molecular species, the probability to obtain a given molecule, and the required isotopic ratios are calculated. The isotopic ratios of the whole mixture can be calculated very simply by measuring (p−1) independent molecule concentration ratios. The advantages of this method which does not involve any absolute measurement and does not depend upon the number of isotopes in the mixture are shown. The theoretical application of the reported method to a mixture of hydrogenated, deuterated, and tritiated propanes is examined. (auth)

19490 SEPARATION OF RARE EARTHS BY ION-EXCHANGE CHROMATOGRAPHY. III. Analysis of Erbium, Thulium, Ytterbium, and Lutetium. Brunisholz, G.; Roulet, R. (Univ., Lausanne). J. Chromatogr.; 75: No. 1, 101-107(3 Jan 1973). (In French).

A displacement chromatography technique is described for the simultaneous determination of the heavy rare earths, Er, Tm, Yb, and Lu. Its sensitivity is given, together with the influence of other cations. The method is applicable to trace analysis and to the analysis of rare earths ores if thorium is previously eliminated. (auth)

19491 QUANTITATIVE AND RAPID SEPARATION OF Zr(IV) AND Hf(IV) BY THIN-LAYER CHROMATOGRAPHY. Spectrophotometric Determination of Hf(IV) with Chloranilic Acid. Olsina, R.; Dapas, R.; Marone, C. (National Univ. of Cuyo, San Luis, Argentina). J. Chromatogr.; 75: No. 1, 93-99(3 Jan 1973).

By using a thin layer chromatographic technique on Silica Gel G, Zr(IV) and Hf(IV) at different concentrations can be separated quantitatively in 45 min. An $HCl-H_3PO_4-H_2O$ (10:1:9) mixture was used to develop the plates. Forty-three ions were chromatographed. Only Ag(I), Tl(I) and W(VI) remained in the spot area with Zr(IV). The R_R values of the other individual ions were higher than 0.6. A spectrophotometric method was developed for the determination of Hf(IV) with chloranilic acid. (auth)

19492 DETERMINATION OF INDIUM AND ZINC, INDIUM AND LEAD IN ARTIFICIAL MIXTURES BY GRADUAL AMPEROMETRIC, TITRATION WITH COMPLEXON III. Zhdanov, A. K.; Akent'eva, N. A.; Korytko, P. K. (Tashkent State Univ.). Dokl. Akad. Nauk Uzb. SSR; No. 7, 33-34(1972). (In Russian).

The conditions were studied for separate determinations of In−Zn and In−Pb in artificial mixtures by a Complexon method of amperometric titration with a rotating Ta electrode. In was titrated on a background of HNO_3, and then the conditions were altered (lowering of the electrode potential and an increase in pH) so as to permit titration of the second component. The accuracy and reproducibility were satisfactory. (KSW)

19493 DETERMINATION OF RHENIUM IN NICKEL–MOLYBDENUM ALLOYS. Merkulova, K. S.; Bruile, E. S. J. Appl. Chem. USSR (Engl. Transl.); 45: No. 7, 1675-1676(Jul 1972).

Translated from Zh. Prikl. Khim.; 45: No. 7, 1606-1607(Jul 1972).

A method was developed for determining small amounts of rhenium (about 1%) in nickel-based alloys containing up to 30% molybdenum. The alloy was decomposed by dissolving a weighed sample in hydrochloric acid with addition of nitric acid. Dry calcium oxide was added to the solution to separate elements that interfere. Rhenium was determined by the colorimetric thiourea method using a spectrophotometer. The error in the determination did not exceed 1.78%. (MCG)

19494 QUANTITATIVE DETERMINATION OF EUROPIUM BY IODOMETRIC TITRATION OF ITS ARSENATE. Shakhtakhtinskii, G. B.; Valiev, B. S.; Agaeva, R. A. Azerb. Khim. Zh.; No. 1, 107-110(1972). (In Russian).

A new arsenate method was developed for the iodometric determination of europium over a concentration range 100 to 1 mg in solutions of chemically pure salts. The optimum conditions for precipitating the difficultly soluble arsenate of Eu were studied: the temperature, acidity (0.04 N HCl or HNO_3), conditions for washing the precipitate, and effect of excess precipitant. Dissolution of the washed arsenate in hot, dilute H_2SO_4 was followed by iodometric titration of the liberated arsenic acid: excess KI solution was added and the elemental I formed was titrated with sodium thiosulfate. (KSW)

19495 SPECTROPHOTOMETRIC DETERMINATION OF PLATINUM AND IRIDIUM IN AMERICIUM. Bartscher, W.; Kramer, W. (Europaeisches Institut fuer Transurane, Karlsruhe, Ger.). Anal. Chim. Acta; 63: No. 1, 216-219(Jan 1973). (In German).

Through thermal distillation, pure metallic americium is obtained from intermetallic compounds of americium with platinum or iridium. Both phase analysis of the intermetallic compounds and purity tests of the distilled americium require sensitive methods for the determination of platinum and iridium. Based on the fact that platinum and iridium form colored complexes with tin(II) chloride, spectrophotometric methods are developed and described. Americium itself fails to interact with the tin complexes and its weak coloration requires only a simple correction of the measured values. The limits of the method are 180 ppM for platinum and 30 ppM for iridium. (HBG)

19496 POLAROGRAPHIC DETERMINATION OF Nb(V) IN THE PRESENCE OF COMPLEXONE IV (CyDTA). Popa, G.;

Lerch, R.; Cazacu, I. C. (Univ., Bucharest). An. Univ. Bucuresti, Chim.; 19: No. 2, 9-15(1970).

The polarographic behavior of a solution of potassium niobate in the presence of Complexone IV (CyDTA) was investigated. The effect of pH, buffer, concentration of CyDTA, and concentration of niobium on the equilibrium of the process of polarographic reduction, was examined. The instability constant of the complex formed was also evaluated. (auth)

19497 BERILLON II AS A REAGENT FOR THE PHOTOMETRIC DETERMINATION OF THE RARE-EARTHS ELEMENTS. Bagbanly, I. L.; Rustamov, N. Kh. (Inst. of Inorganic and Physical Chemistry, Baku). Dokl. Akad. Nauk Azerb. SSR; 28: No. 4, 42-46(1972). (In Russian).

Under certain conditions, berillon II formed complex compounds with La, Pr, and Nd with maximum absorptions at 610 nm. Under these conditions, the reagent is absorbed at 555 nm. At pH 8.2, complex compounds are formed with a 1:1 composition. The molecular absorption coefficients were: La = $2{,}3326 \times 10^4$; Nd = 2.194×10^4; and Pr = 1.26×10^4. The formation constants were: La = 1.666×10^5; Nd = 4.566×10^4; and Pr = 6.24×10^4. The photometric method permits the determination of 5 to 1200 mkg of rare earth elements in 50 ml volumes. (auth)

19498 SPECTROPHOTOMETRIC DETERMINATION OF MOLYBDENUM(VI) BY SOLVENT EXTRACTION OF MOLYBDENUM(VI)-INDOFERRON CHELATE. Wakamatsu, Y. (Hachinohe Technical Coll., Japan); Otomo, M. Jap. Anal.; 21: No. 12, 1650-1652(Dec 1972). (In Japanese).

A method is proposed for the spectrophotometric determination of molybdenum(VI), which is based on the extraction of a molybdenum(VI)-indoferron chelate into chloroform in the presence of 1,3-diphenylguanidinium (DPG) salt. The combining ratio of molybdenum(VI), indoferron, and DPG in the extracted species was shown to be 1:2:1. The extracted species had an absorption maximum at about 555 nm, and the maximum absorbance of the organic phase was obtained when the pH of the aqueous phase was between 1.5 and 2.1. Under the optimum conditions, Beer's law was obeyed up to 67 μg molybdenum(VI) per 10 ml chloroform. The molar absorption coefficient of the extracted species is about 1×10^4 cm^2 mol^{-1} at 555 nm. Interfering cations such as iron(III), titanium(IV), and zirconium(IV) can be masked by addition of EDTA. (auth)

19499 SIMULTANEOUS DETERMINATION OF COPPER, LEAD, AND CADMIUM IN TANTALUM BY SQUARE-WAVE POLAROGRAPHY. Mizuike, A.; Miwa, T.; Fujii, Y. (Nagoya Univ., Japan). Jap. Anal.; 21: No. 12, 1645-1647(Dec 1972). (In Japanese).

Copper, lead, and cadmium at the ppB level in high-purity tantalum metal are determined simultaneously by square-wave polarography after removal of tantalum by anion exchange. A 1-g sample is dissolved in a mixture of hydrofluoric and nitric acids in a Teflon beaker, and the solution (20 ml, 4 M in F^- and 0.5 M in NO_3^-) is introduced onto an anion-exchange column (Bio. Rad AG 1-X8, 100 ~ 200 mesh, 10 mmϕ × 150 mm, polyethylene tubing). Then 20 ml of the mixed acid (4 M HF + 0.5 M HNO_3) is passed through the column. The effluent is evaporated to dryness and the residue is dissolved in 5 ml of the supporting electrolyte containing 0.5 M potassium chloride-0.1 M hydrochloric acid. The lower limits of determination are 0.05 ppM for copper, 0.1 ppM for lead, and 0.02 ppM for cadmium, and the precision is about 10% at the 0.2 ppM level. The time required for a determination is approximately 5 to 6 hrs. (auth)

19500 SPECTROPHOTOMETRIC DETERMINATION OF MOLYBDENUM(VI) BY SOLVENT EXTRACTION WITH TIRON IN THE PRESENCE OF ZEPHIRAMINE AND ITS APPLICATION TO THE DETERMINATION OF MOLYBDENUM IN IRON AND STEEL. Nakatani, M. (Sasebo Technical Coll., Nagasaki, Japan). Jap. Anal.; 21: No. 12, 1624-1629(Dec 1972). (In Japanese).

It was found that molybdenum reacts with tiron in the presence of zephiramine to give a yellow precipitate (molybdenum-tiron-zephiramine ternary complex) that has an absorption maximum at 390 nm when extracted into chloroform at pH 8.0. This spectrum of the complex may be used in the spectrophotometric determination of molybdenum, but such ions as iron (III), vanadium (V), and perchlorate interfere seriously with the determination. To prevent the interference of these ions, molybdenum was extracted into chloroform as α-benzoinoxime complex, which then reacted with tiron in the presence of zephiramine to form the molybdenum-tiron-zephiramine ternary complex in chloroform. This reaction was applied to the determination of molybdenum in iron and steel. Analytical results of the standard samples of iron and steel by this method were satisfactory. The addition of L-ascorbic acid solution in extracting the complex did not affect the determination of molybdenum, but the coexistence of tungsten interfered with the determination, so in the case of tungsten-bearing steel, it was necessary to remove tungsten prior to the extraction of the molybdenum complex. (auth)

19501 DETERMINATION OF MOLYBDENUM, TITANIUM, AND VANADIUM IN ATOMIC ABSORPTION SPECTROPHOTOMETRY. Oddo, N. (Perkin-Elmer Italiana SpA, Milan). Met. Ital.; 64: No. 8, 359-362(Aug 1972). (In Italian).

Some limits of the flame as a sampling system in atomic absorption spectrophotometry are explained and some flameless sampling systems proposed previously are briefly described. Tests on Mo, Ti, and V using mod. HGA-70 flameless graphite tube sampling system are then shown. Sensitivity, detection limits, and analytical reproducibilities of these elements are described. Possible interferences due to matrices rich in iron, nickel, and titanium were checked. The proposed system shows remarkably higher sensitivity and detection limits than the traditional flame, and reproducibilities appropriate to the analytical needs. The intermetallic interferences are less or equal to those measured previously with flame as the sampling system. (auth)

19502 APPLYING A SMALL ELECTRONIC COMPUTER TO QUANTOMETRIC ANALYSES. Riegler, A. (FIAT, Milan). Met. Ital.; 64: No. 8, 363-368(Aug 1972). (In Italian).

The use of the small electronic P 203 Olivetti computer is described for automatically translating in analytical percentages the data readings from a digital voltmeter in quantitative analyses. Data for determining Si, Mo, C, Cr, and Mn are given as example. (auth)

19503 INTERNAL STANDARDIZATION IN ATOMIC EMISSION AND ABSORPTION SPECTROMETRY. Feldman, F. J. (Instrumentation Lab. Inc., Lexington, MA). Met. Ital.; 64: No. 8, 369-374(Aug 1972). (In Italian).

Some of the various factors are studied that affect the resulting signal in atomic absorption and emission. Changes in fuel and air flow, matrix composition, and aspiration rate are extremely difficult to control, and will adversely affect the precision. Internal standardization effectively reduces or eliminates the variations in these factors allowing for high precision measurements. Some selection rules and experimental studies for determining the efficiency of an internal standard are presented. Limitations in the use of internal standards are discussed. Hybridization techniques, i.e., simultaneous emission and absorption measurements, can be used for greater latitude in the selection of internal standards. Increases of 2- to 3-fold in precision as well as higher accuracy are found utilizing internal standardization. (auth)

19504 DETERMINATION OF HYDROGEN IN Pu METAL. Vienney, J. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). pp 202-203 of International Congress on Hydrogen in Metals. Vols. 1 and 2. Paris; Editions Science et Industrie (1972).

From International Congress on Hydrogen in Metals Conference; Paris, France (29 May 1972). See CONF-720571-(Vol. 1 and 2).

The hot vacuum extraction method was used. This method has the advantages of requiring very little manual intervention and enabling the sample to be easily recovered in view of analysis. The apparatus used is described. The dependence on the temperature, degassing, time, and the form of the samples was studied. (FR)

19505 DETECTION OF TRACE AMOUNTS OF MANGANESE ISOTOPES BY SURFACE IONIZATION METHOD. Gensho, R.; Takeuchi, S.; Honda, M. (Tokyo Univ.). Shitsuryo Bunseki; 20: No. 3, 211-222(Sep 1972). (In Japanese).

Mass spectrometric determinations for trace amounts of radioactive ^{54}Mn and ^{53}Mn in the presence of ^{55}Mn were studied. Both ^{54}Mn and ^{53}Mn are readily produced by nuclear reactions. Absolute amounts of each isotope could be obtained from the disintegration rate of ^{54}Mn and the isotope ratios of ^{54}Mn to the others. In order to find suitable experimental conditions in the isotope ratio measurements, a commercially available carrier-free ^{54}Mn was used as the sample. The manganese fraction was extracted from the sample containing 10^7 dpm of ^{54}Mn and was purified for mass spectrometric measurements by a wet chemical method. A silica gel method was applied for the solid source surface ionization and a pulse-counting method was improved to measure the extremely weak ion beam current. In one run about 10^{11} atoms of ^{54}Mn could be determined with a high reproducibility in the presence of about 10^{14} atoms of ^{55}Mn. Furthermore, coexisting ^{53}Mn at the level of 10^{10} atoms could also be detected with about ±10% error. This method was applied to determine the production cross sections of ^{54}Mn and ^{53}Mn induced in a cyclotron-irradiated iron target. (auth)

19506 SPECTROPHOTOMETRIC DETERMINATION OF THORIUM(IV) USING 3-NITROSO-4-HYDROXYCOUMARIN.

Manku, G. S. (Hans Raj Coll., Delhi). Mikrochim. Acta; No. 6, 811-817(1972).

3-Nitroso-4-hydroxycoumarin is suggested as a new reagent for the spectrophotometric determination of 125 μg to 0.50 mg Th(IV) in 3 : 1 dioxan : water medium as 1 : 1 complex having orange red color with absorption maximum at 419 nm, at pH 4.5 to 6.0. For the estimation of 9.6 ppM Th(IV) 100-folds acetate, citrate, tartrate; 50 ppM UO_2^{2+}, 75 ppM Ce^{3+}, La^{3+}, Gd^{3+}; 4.5 ppM Ce^{4+}; 25 ppM Tm^{3+}, Zr^{4+}; and 100 ppM Tl^{4+}, V^{5+}, MoO_4^{2-} and WO_4^{2-} do not interfere. (auth)

19507 DETERMINATION OF URANIUM IN GEOLOGIC SPECIMENS AFTER THE SEPARATION OF THE URANIUM BY ANIONIC EXCHANGE. Korkisch, J.; Steffan, I. (Univ., Vienna). Mikrochim. Acta; No. 6, 837-860(1972). (In German).

A description is given of a method for the determination of uranium that is generally applicable to the analysis of geologic specimens after the uranium has been separated. This separation is based on the selective adsorption of the uranium on strongly basic anion exchanger Dowed 1 × 8 from a mixture of 50 volume % tetrahydrofurane, 40 volume % methylglycol, and 10 volume % 6 N hydrochloric acid. The coadsorbed foreign ions, such as Cu(II), Co(II), and Mn(II) are removed by washing with pure aqueous 6 N hydrochloric acid, and the uranium is finally eluted with 1 N hydrochloric acid. The uranium is then determined in the eluate either fluorometrically or by the titrimetric method, depending on the uranium content of the original sample. This separation procedure was employed for determining the uranium content of 189 geologic specimens. (auth)

19508 USE OF GALLACETOPHENONE AND GALLOBENZOPHENONE FOR THE SPECTROPHOTOMETRIC DETERMINATION OF URANIUM(VI). Popa, G.; Ciurea, I. C.; Dumitrescu, N.; Buburuzan, D. (Univ., Bucharest). Mikrochim. Acta; No. 6, 883-888(1972). (In German).

The color reactions of uranium(VI) with gallacetophenone and gallobenzophenone were studied spectrophotometrically. At pH ≈ 4.6 and λ = 380 nm uranium(VI) could be determined with these reagents between 1.2 and 40 μg/ml and 0.8 and 20 μg/ml respectively. The molar absorptivities ϵ_M^{380} were ≈ 6000 and ≈ 9000 $l \cdot mol^{-1} \cdot cm^{-1}$ respectively. Relatively large amounts of cadmium, zinc, manganese, cobalt, and nickel do not interfere. (auth)

19509 COMPARATIVE TESTS FOR DETERMINING NITROGEN IN TANTALUM. Kraft, G. (Metallgesellschaft AG, Frankfurt am Main); Paesold, G.; Tombu, C. G.; Lassner, E. J. Less-Common Metals; 30: 311-313(1973). (In German).

To determine the nitrogen content of solid and powdered tantalum, four methods were compared: the Kjeldahl procedure, treatment with NaOh, heat extraction with carrier gas stream, and vacuum heat extraction. Results showed a satisfactory agreement between the various procedures. The alleged superiority of the wet chemical over the heat extraction techniques thus was not confirmed. (HBG)

Radiometric and Radiochemical Procedures

Refer also to abstracts 19588, 19744, 19876, and 19910.

19510 (CONF-721010-32) SOME ANALYTICAL INVESTIGATIONS INTO THE USE OF X RAYS EMITTED DURING CHARGED-PARTICLE IRRADIATION. Peisach, M.; Newton, D. A.; Peck, P. F.; Pierce, T. B. (Atomic Energy Research Establishment, Harwell (England)). 1972. 11p. Dep. NTIS (U. S. Sales Only).

From International Conference on Modern Trends in Activation Analysis; Saclay, France (2 Oct 1972).

X-radiation emitted as a result of charged particle irradiation offers a means of extending the scope of analytical methods based on the measurement of prompt radiation. X-ray yields from a number of pure materials were examined over a range of particle energies and x-ray measurement applied to the determination of a number of constituents in aluminium alloys. An examination of the distribution of silicon and germanium across an electronic component was carried out using a small diameter incident ion beam. (auth)

19511 (CONF-721134-1) DEVELOPMENT OF HIGH SENSITIVITY X-RAY FLUORESCENCE FOR ANALYSIS OF TOXIC HEAVY ELEMENTS. Sparks, C. J. Jr.; Harris, L. A. (Oak Ridge National Lab., TENN). 1972. 9p. Dep. NTIS.

By adapting a compression annealed pyrolytic graphite monochromator to reduce the white radiation from the x-ray target and by placing a second doubly curved graphite monochromator between the sample and the Si(Li) detector, the detectable limits were lowered to 200 ppB for mercury. (DHM)

19512 (MLM-1955) MOUND LABORATORY CHEMISTRY AND PHYSICS PROGRESS REPORT: APRIL – JUNE 1972. (Mound Lab., Miamisburg, Ohio). 29 Dec 1972. Contract AT-33-1-GEN-53. 32p. Dep. NTIS.

AMERICIUM-241 — determination of trace amounts of, in plutonium-239 by counting 60 keV γ using NaI(Tl) crystal and multichannel analyzer, pp. 18-20

DIFFERENTIAL THERMAL ANALYSIS — instrumentation for, development of compact furnace and sensor assembly for, pp. 30-1

HYDROGEN — determination in tantalum–tungsten alloys and T-111 alloy by vacuum fusion, pp. 22-4

NITROGEN — determination in tantalum–tungsten alloys and T-111 alloy by vacuum fusion, pp. 22-4

OXYGEN — determination in tantalum–tungsten alloys and T-111 alloy by vacuum fusion, pp. 22-4

PLUTONIUM — complexation in natural waters, problems in determining degree of, pp. 14-15

— determination in plutonium metal by potentiometric titration, pp. 16-18

— analysis for impurities by carrier distillation emission spectroscopy, sample preparation for, pp. 25-7

PROTACTINIUM — separation from protactinium–thorium rich concentrate by extraction using DEHPA and sodium carbonate stripping, pp. 7-13

— separation from protactinium–thorium rich concentrate by extraction using TOPO, pp. 7-13

PROTACTINIUM-231 — determination in protactinium–thorium rich concentrate by γ spectrometry, pp. 7-13

T-111 (TANTALUM ALLOY) — analysis for hydrogen, nitrogen, and oxygen by vacuum fusion, pp. 22-4

THORIUM — separation from protactinium–thorium rich concentrate by extraction using DEHPA and sodium carbonate stripping, pp. 7-13

— separation from protactinium–thorium rich concentrate by extraction using TOPO, pp. 7-13

THORIUM-230 — determination in protactinium–thorium rich concentrate by γ spectrometry, pp. 7-13

TRITIUM — monitoring in air, system for continuous

TUNGSTEN ALLOYS AND SYSTEMS — Ta–W, analysis for hydrogen, nitrogen, and oxygen by vacuum fusion, pp. 22-4

URANIUM — determination by instrumental x-ray fluorescence, pp. 20-2

19513 RADIOREAGENT METHOD FOR THE DETERMINATION OF TRACES OF BISMUTH. Menon, M. P. (Savannah State Coll., GA). Anal. Chim. Acta; 64: No. 1, 151-155(Mar 1973).

A method is described for determining bismuth by converting the bismuth ion to radioactive tetraiodobismuthic acid by treatment with excess iodide labeled with ^{131}I. The active product is extracted into n-butyl acetate and the γ ray activity of a portion of the extract is determined. In establishing the sensitivity limit of 0.04 μg Bi ml^{-1} in the solution before extraction, the specific activity of the reagent used was 2.33×10^5 counts min^{-1} per mmole of iodide. (DHM)

19514 SOLVENT EXTRACTION METHOD FOR THE DETERMINATION OF ^{32}P IN SEA WATER. Flynn, W. W.; Meehan, W. R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Anal. Chim. Acta; 63: No. 2, 483-488(Feb 1973).

Phosphorus-32 is one of the neutron-activated by-products found in reactor coolant system, and discharge of large quantities of coolant water to the sea entails the need for a constant check on this particular nuclide. A method was developed for the determination of ^{32}P that involves the extraction of ^{32}P with carrier as the phosphomolybdate by isoamyl alcohol. A buffered ammonia solution is used to strip the carrier from the solvent and a precipitate $MgNH_4PO_4 \cdot 6 \cdot H_2O$ (P factor −0.1253) is counted in a low background counter. (DHM)

19515 MEASURING OF SOME BETA EMITTERS IN AQUEOUS SOLUTIONS BY MEASUREMENT OF CHERENKOV RADIATION. I. Detection of ^{40}K. Mertl, F. (Karlova Univ., Plzen, Czech.). Jad. Energ.; 19: No. 2, 43-46(Feb 1973). (In Czech).

Results of the determination of KCl in aqueous solutions by means of the detection of Cherenkov radiation, produced by beta particles of the natural radionuclide ^{40}K, are given. The calibration line in the region 10 to 280 mg KCl/20 ml is presented as well as the background values of three different counting vials. The minimal measurable concentration for 20 ml samples is 0.33 mg KCl/ml, or 0.172 mg K/ml. The influence of the presence of some added substances in the samples upon the Cherenkov radiation rate were studied and the possibility of the application of the quench correction methods, used in liquid scintillation counting, were verified. (auth)

19516 IMPROVED EXPERIMENTAL TECHNIQUE FOR REVERSE ISOTOPE DILUTION METHOD. Graham, W. H.; Bornak, W. E. (Rohm and Haas Co., Bristol, PA). Anal. Chem.; 45: No. 3, 623-624(Mar 1973).

The principles involved, the apparatus and procedures used, and the results obtained in trials of a modified reverse isotope dilution (RID) technique are described. Instead of isolating the crystalline material after each recrystallization, it is necessary to radioassay only the mother liquor. This follows from the fact that at equilibrium at constant temperature and with a constant volume of solvent, an equal amount of solute will be dissolved independent of the amount of solid or crystalline phase present. Therefore, two consecutive recrystallizations of a chemically pure but radiolabeled material will contain the same amount of radioactivity in the same volume of mother liquor at constant temperature. At that point the crystalline material may be isolated and radioassayed to determine its specific activity and complete the analysis. (DHM)

19517 COMPARISON OF THREE EXTRACTION AND CLEANUP METHODS FOR DETERMINING ^{14}C-LABELED RESIDUES FROM WHEAT PLANTS GROWN IN SOIL TREATED WITH DYFONATE-RING-^{14}C. Saha, M.; Sumner, A. K.; Saha, J. G. (Univ. of Saskatchewan, Saskatoon). J. Ass. Offic. Anal. Chem.; 56: No. 1, 45-48(Jan 1973).

Three methods for determining organophosphorus insecticide residues in plant tissues were compared for efficiency of extraction and cleanup of ^{14}C-labeled residues from wheat plants grown in soil treated with Dyfonate-ring-^{14}C. Blending with ethyl acetate recovered 70.5% of the radioactivity present in the plant tissues and cleanup of the extract by sweep co-distillation recovered 99% of the radioactivity. Blending of plants with benzene recovered about 58% of the radioactivity and subsequent cleanup of the extract on a silica gel column recovered about 78% of the activity. Although blending with acetonitrile recovered 59% of the radioactivity present in the plant tissue, partitioning of the extract between water and petroleum ether or chloroform retained only about 14 and 30% of the activity in the organic layer, respectively. Thus, the overall efficiency of this procedure was only between 8 and 18% as compared to 45 and 70% in the other 2 methods. (auth)

19518 GAMMA SPECTROSCOPIC DETERMINATION OF ^{137}Cs IN MILK, USING SIMULTANEOUS EQUATIONS: Collaborative Study. Baratta, E. J.; Knowles, F. E. Jr. (Environmental Protection Agency, Winchester, MA). J. Ass. Offic. Anal. Chem.; 56: No. 1, 204-207(Jan 1973).

A gamma spectroscopic method, using a sodium iodide (thallium-activated) crystal, was evaluated by 25 collaborators for the determination of cesium-137 in milk. Overall average recoveries of 295 ± 18.1 and 53 ± 5.3 pCi/L were obtained for samples containing 305 and 52 pCi/L, respectively. These samples also contained iodine-131 and barium-140, which did not interfere with the analyses. The slight bias on the low side and the greater dispersion of results for the low level sample were not considered serious. The method has been adopted as official first action. (auth)

19519 DETERMINATION OF ^{90}Sr IN WATER: COLLABORATIVE STUDY. Baratta, E. J.; Knowles, F. E. Jr. (Environmental Protection Agency, Winchester, MA). J. Ass. Offic. Anal. Chem.; 56: No. 1, 208-212(Jan 1973).

A procedure involving carbonate precipitation and purification with nitric acid was evaluated by 11 collaborators for the determination of strontium-90 in water. The ingrowth level of yttrium-90 is counted and this activity is used to calculate the strontium-90 activity present. The accuracy of the method ranged from 9 to 16% and within-laboratory precision ranged from 13 to 19% for strontium-90 levels of 28.2 to 99.6 pCi/L. A slight bias on the low side, caused by individual laboratory techniques, was not considered serious. The method has been adopted as official first action. (auth)

19520 ION EXCHANGE DETERMINATION OF ^{89}Sr and ^{90}Sr IN MILK: COLLABORATIVE STUDY. Baratta, E. J.; Knowles, F. E. Jr. (Environmental Protection Agency, Winchester, MA). J. Ass. Offic. Anal. Chem.; 56: No. 1, 213-218(Jan 1973).

A method for the determination of strontium-89 and strontium-90 in milk, involving ion exchange and purification with nitric acid, was evaluated by 11 collaborators. The accuracy of the method for strontium-89 ranged from 2 to 56% and the within-laboratory precision ranged from 11 to 76% for a concentration range of 68 to 480 pCi/L; values for strontium-90 in a concentration range of 50.2 to 116.2 pCi/L were 6.4 to 10 and 4 to 11%, respectively. The slight bias on the high side for strontium-90 was not considered serious. The collaborators had difficulty with strontium-89 analyses, as shown by the high precision and accuracy estimation values. (auth)

19521 COMPARISON OF PARTICLE AND PHOTON EXCITED X-RAY FLUORESCENCE APPLIED TO TRACE ELEMENT MEASUREMENTS OF ENVIRONMENTAL SAMPLES. Cooper, J. A. (Battelle Northwest Labs., Richland, WA). Nucl. Instrum. Methods; 106: No. 3, 525-538(1973).

The sensitivities of particle and photon excitation methods of x-ray fluorescence were compared for the analysis of trace elements in environmental samples. The analysis sensitivity for comparing different methods of excitation has been shown to be proportional to the square root of the product of the peak to background ratio at the x-ray energy of interest and the peak to total ratio. The sensitivities possible with high energy alpha particle excitation are in the tens of ppM range while excitation by low energy proton, transmission tube x-rays and 100 mCi radioisotopic sources provide sensitivities in the 1 to 5 ppM range for environmental material in analysis times of about 10 min. Fifteen to twenty-five elements can be detected at the concentrations present in typical environmental samples with demonstrated quantitative techniques available for the measurement of 10 to 20 elements, depending on sample type. The results indicate that low energy proton excitation techniques do not exhibit analysis capabilities significantly different from those of photon excitation methods while high energy alpha excitation is not competitive. (auth)

19522 MICRORADIOGRAPHIC STUDY OF GRANULES OF STYRENE-DIVINYLBENZENE ANION EXCHANGERS OF THE PYRIDINIUM TYPE. Vodolazov, L. I.; Kononova, T. G.; Laskorin, B. N.; Pribytkov, P. V. J. Appl. Chem. USSR (Engl. Transl.); 45: No. 6, 1284-1288(Jun 1972).

Translated from Zh. Prikl. Khim.; 45: No. 6, 1242-1247(Jun 1972).

The distribution of U on high-polymer ion exchange materials was studied by recording α tracks. The degree of saturation with U with increasing content of crosslinking agent was found to be more rapid in the isooctane series of AMP-p resin than in the benzene series. Most specimens of AMP and AMP-p resins were found to have a medium distribution density for α tracks, while specimen PPS of AMP-p × 20 resin has a low distribution density. (JGB)

19523 DETECTION OF LABELLED FRACTIONS FROM GLC COLUMNS. Lubkowitz, J. A. (Instituto Venezolano de Investigaciones Cientificas, Caracas, Venezuela). pp 129-135 of Radiotracer Studies of Chemical Residues in Food and Agriculture. Vienna; International Atomic Energy Agency (1972).

From Radiotracer Studies of Chemical Residues in Food and Agriculture Meeting; Vienna, Austria (25 Oct 1971). See STI/PUB-332; CONF-711069-.

Different methods for the detection of labeled compounds emerging from GLC columns are compared. High-temperature operating GM-detectors were used to study the feasibility of analyzing by GLC ^{14}C-aldrin of specific activity of 1 mCi/mM. The passage of impurities causes a decrease in the pulse amplitude of the GM counter. A two-detector system in series is used to correct for the quenching. One detector has a standard ^{14}C-source. The accumulated counts at each detector permit efficiency corrections. Each analytical detector has a corresponding detector for background subtraction. The system is capable of detecting 8 nCi of ^{14}C-aldrin, which is equivalent to a 50 ppM residue for a specific activity of 1 mCi/mM. The system has the capability of detecting labeled and non-labeled compounds. (auth)

19524 THEORY AND OPTIMIZATION OF THE RADIOMETRIC ABSORPTION METHOD USED TO ANALYZE BINARY SYSTEMS. Kubicek, P.; Mrazek, L. Isotopenpraxis; 8: No. 9, 343-351(Sep 1972). (In German).

The resolution of the absorption method when used to analyze binary systems through monoenergetic γ- or x-ray radiation is treated theoretically. An analytical relation is derived for the function Δp that characterizes the minimum change in composition of the system to be determined. The extrema of the function Δp are used to find the optimum values of energy, thickness of layer, and emission rate as well as the remaining parameters in a way to obtain maximum resolution of the method. The theory is applied to a silver-copper alloy. (auth)

19525 METHOD FOR EVALUATING BACKGROUND NOISE IN MEASURING NUCLIDE ACTIVITY. Fominykh, V. I.; Migun'kov, O. A. Meas. Tech. (USSR) (Engl. Transl.); 15: No. 4, 608-9(Apr 1972).

Translated from Izmer. Tekh.; 15: No. 4, 66(Apr 1972).

A method for determining background noise in activity measurements of radioisotopes is described. The counting rates corresponding to the activity and the background noise are measured at different sequential time intervals. (WHK)

19526 PHOTODENSITOMETRIC INVESTIGATION OF THE CONDITIONS OF TRITIUM DETERMINATION ON PAPER CHROMATOGRAMS BY FLUOROGRAPHY. Tykva, R.; Pavlu, B. (Inst.

of Organic Chemistry and Biochemistry, Prague). Collect. Czech. Chem. Commun.; 38: No. 1, 25-28(Jan 1973).

During the determination of tritium radioactivity on paper chromatograms by fluorography, quantitative measurements were made on the dependence of the blackening on the type of paper used, on the sample radioactivity per area unit, concentration of the scintillating substance, reflector, and the wave-length shifter. On the basis of the measured relationships working conditions are proposed for the assay of radiochemical purity of tritiated compounds. (auth)

19527 QUANTITATIVE RADIOMETRIC DETERMINATION OF ALKALOIDS USING LABELLED POTASSIUM TETRAIODOMERCURATE. Nour, A. M.; Saleh, A. A.; Habib, A. E. M.; Hamad, N.; Shalaby, A. F. Isotopenpraxis; 8: No. 7, 274-275(Jul 1972).

A microquantitative radiometric method by which minute amounts of alkaloid can be determined is described. A technique is described in which Mayer's Reagent labelled with sodium iodide (^{131}I) is used and by which amounts of as little as 20 μg alkaloid in a volumn of solution as small as 10 μl can be assayed. (JGB)

19528 DETERMINATION OF TIN CONTENT IN ORE PULPS THROUGH ROENTGENFLUORESCENCE EXCITATION BY MEANS OF A RADIONUCLIDE AS AN X-RADIATION SOURCE. Brunner, G.; Dahn, E. (Zentralinstitut fuer Isotopen- und Strahlenforschung, Leipzig). Isotopenpraxis; 8: No. 8, 300-305(Aug 1972). (In German).

The development of a measuring unit for continuous determination of tin content in ore pulps directly at the pulp stream is reported. The effects of the measuring window, the grain size, the pulp density, and the atomic number both of the secondary target and the filter are discussed. The measuring unit comprises a sensitive element and an industrial counter of the VA-M-10 type as measuring center. The sensitive element consists of a scintillation detector with an ^{241}Am x-radiation source and secondary radiation target. (auth)

Separation Procedures

Refer also to abstracts 19633, 19828, and 21149.

19529 CHELATING ION-EXCHANGERS CONTAINING 8-HYDROXYQUINOLINE AS THE FUNCTIONAL GROUP. Vernon, F.; Eccles, H. (Univ. of Salford, Eng.). Anal. Chim. Acta; 63: No. 2, 403-414(Feb 1973).

The oxine-containing chelating ion-exchangers described in the literature were synthesized and their properties determined. Total capacities for copper, cobalt, nickel, zinc, aluminium, and uranyl ions as a function of pH are given, together with equilibration rates and swelling properties. Detailed analysis of the various exchangers has shown that other factors are responsible for chelation in addition to the oxine groups present. Column separations on one exchanger, with a specific method for uranium isolation, are described. (auth)

19530 ION EXCHANGE IN AQUEOUS AND IN AQUEOUS-ORGANIC SOLVENTS. Part I. Anion-exchange behavior of Zr, Nb, Ta, and Pa in aqueous HCl-HF and in HCl-HF-organic solvent. Kim, J. I.; Lagally, H.; Born, H. J. (Technische Univ., Garching, Ger.). Anal. Chim. Acta; 64: No. 1, 29-43(Mar 1973).

Ion exchange behaviors of Zr(IV), Nb(V), Ta(V), and Pa(V) on the anion exchanger Dowex 1-X8 are investigated first in a wide variety of aqueous mixed hydrochloric acid-hydrofluoric acid and secondly in the same aqueous system mixed with various organic solvents. Equilibrium adsorptions of these four elements as a function of hydrochloric acid concentration as well as hydrofluoric acid concentration, or both acid concentrations, were found to be strongly differentiated. This fact can be utilized for convenient separations of these elements from each other. Based on the equilibrium adsorption results, the possible complex formation of the metal ions and the separation possibilities for the elements are discussed. (auth)

19531 INFLUENCE OF TEMPERATURE ON EXTRACTION OF SEXIVALENT MOLYBDENUM INTO TRIALKYLAMINE FROM HYDROCHLORIC ACID SOLUTIONS. Palant, A. A.; Reznichenko, V. A. (Inst. of Metallurgy, Moscow). J. Appl. Chem. USSR (Engl. Transl.); 45: No. 7, 1705-1706(Jul 1972).

Translated from Zh. Prikl. Khim.; 45: No. 7, 1631-1632(Jul 1972).

The molybdenum content in the original hydrochloric acid solutions varied in the range (0.98 to 1.01) $\times 10^{-2}$M. The acidity of these solutions was varied from 0.488 to 5.60N HCl. The effects of temperature in the range from 10 to 60°C were determined. At acidities below 1.5N HCl the distribution coefficient increased with increasing temperature, while at acidities above 3N HCl increasing temperature decreased extraction of molybdenum. (MCG)

19532 RADIOACTIVE ISOTOPE FRONT LABELLING FOR THE INVESTIGATION OF TECHNICAL ION EXCHANGE PROCESSES. Gebhardt, G. (Forschungsinstitut fuer NE-Metalle, Freiberg, Ger.). Isotopenpraxis; 8: No. 9, 340-342(Sep 1972). (In German).

Radioactive isotopes have proved their extraordinary suitableness for the investigation of ion exchange processes as they provide direct control of the concentration of components both in the eluate and in the column. However, technical experiments were subject to certain difficulties arising with regard to the use of radioactive isotopes owing to the fact that labeling of comparatively large quantities of solution had to be performed. It would be very useful if the quantity of some radionuclide used to label a given solution could be substantially reduced without doing any harm to the power of evidence of the experiment, i.e. by labeling just the front of the given element. The ion exchange theory suggests such a possibility; an experiment carried out using ^{60}Co showed that radioactive Co within the front of nonradioactive Co shows the behavior postulated by theory. This possibility has been successfully used in a technical experiment performed to clean a platinum-rhodium solution by means of a cation exchanger. (auth)

19533 MECHANISM OF THE EXTRACTION OF TELLURIUM (IV) FROM HYDROCHLORIC ACID MEDIUM WITH SATURATED ALIPHATIC MONOKETONES. Havezov, I. (Kernforschungsanlage, Juelich, Ger.); Nuernberg, H. W.; Stoeppler, M.; Jordanov, N. Z. Anal. Chem.; 262: No. 3, 179-183(1972). (In German).

The extraction solvents studied were methyl ethyl ketone, methyl isopropyl ketone, methyl isobutyl ketone and diisobutyl ketone. When methyl isobutyl ketone is used as extractant the formula $H_2Te(OH)_2Cl_4 \cdot Ket_5(H_2O)_{4-5}$ is proposed for the extractable compound. Both hydrogen ions formed by dissociation of the acid are hydrated in their primary solvation shell while the water molecules of the primary hydration shell are further solvated in a secondary shell by ketone molecules bound to them via hydrogen bridges. The anion $[Te(OH)_2Cl_4]^{2-}$ is probably solvated by ketone via $-OH-O{=}C$ bonds. (auth)

19534 EFFECT OF CONCENTRATION OF INORGANIC LIGAND ON EXTRACTION OF METAL IONS BY OXO SOLVENTS IN LIQUID-LIQUID PARTITION CHROMATOGRAPHY. Soczewinski, E.; Manko, R. (Dept. of Inorganic and Analytical Chemistry, Lublin). Rocz. Chem.; 46: No. 10, 1821-1828(1972).

Relationships between R_F values of 46 metal ions, including rare earths, Th, and U, and ligand concentrations were investigated for systems of the type: oxo solvent-aqueous solutions of NH_4SCN or HCl. (auth)

19535 ION EXCHANGE CHROMATOGRAPHIC SEPARATION OF SELENIUM, TELLURIUM, AND BISMUTH FROM NITRIC ACID SOLUTIONS. Babayan, G. G.; Kapantsyan, E. E.; Oganesyan, E. N. (Erevan State Univ.). Arm. Khim. Zh.; 25: No. 4, 291-295(1972). (In Russian).

Se was separated from Bi and Te at a pH of 2 to 3, and Te from Bi in 0.5 N HNO_3 using a cation exchanger (KU-2-H^+). With an anion exchanger (AV-17) in the chloride form, it was possible to separate Bi from Se at acidities from pH of 1 to 1 N HNO_3; Se was separable from Te and Bi in 10 N HNO_3. (KSW)

19536 ANION EXCHANGE SEPARATION OF RARE EARTHS IN METHANOL-NITRIC ACID MIXED SOLUTIONS. I. Study on the Distribution Coefficients and Column Elution Method. Chen, Y. M.; Liao, S. C. (National Taiwan Univ., Taipei). J. Chin. Chem. Soc. (Taiwan); 19: No. 3, 93-102(Sep 1972).

An anion exchange method for the mutual separation of rare earth was studied in methanol-nitric acid mixed solutions. For each of rare earth element, the distribution coefficients in different concentrations of nitric acid and also in various compositions of methanol solution were studied with the batch equilibrium method. From these distribution coefficients, elution of rare earth by gradient variation in the compositions of methanol was devised. That is, by keeping constant nitric acid at 2 N acidity and gradiently diluting methanol from its original 80% by volume. Results were satisfactory for the mutual separation of the lighter rare earths, but only fairly for the heavier earths. The secondary metal effect for this anion exchange was also studied in 80% by volume of methanol solution by keeping total concentration of nitrate at 0.8 N. Distribution coefficients were larger than nitric acid with $LiNO_3$ but smaller in the case of NH_4NO_3 and $NaNO_3$. Despite these differences in distribution coefficients, no remarkable differences were observed for the separation factors of adjacent pairs. (auth)

19537 EXTRACTION OF THENOYLTRIFLUOROACETONE COMPLEXES OF EUROPIUM(III) INTO INERT AND ETHER SOL-

VENTS. Akiba, K. (Tohoku Univ., Sendai). Jap. Anal.; 21: No. 12, 1630-1636(Dec 1972). (In Japanese).

Extraction of europium(III) complexes with thenoyltrifluoroacetone (TTA; HA) in organic solvents was investigated at 25°C by using europium 152 + 154 as the tracer from aqueous sodium perchlorate solution in which pH was kept at 2.0 to 4.5 and the ionic strength at 0.1. The chemical form of the extracted species into "inert" solvents was found to be EuA_3, while that into ethers was found to be solvated complexes, $EuA_3 \cdot mS$ (where m = 1, 2), with the solvent molecules (S) and thus a synergistic effect was observed. In order to examine the regularity in the distribution in these systems, the distribution ratios of europium (D_{Eu}) obtained at a definite pA were correlated with the distribution coefficients of TTA (H_{HA}). The correlation between them at pA = 5.50 was found to be $\log D_{Eu} = 2.9 \log P_{HA} - 5.82$ for inert solvents and $\log D_{Eu} = 3.3 \log P_{HA} - 3.48$ for ethers except for a few solvents containing electron-drawing groups. The relation for inert solvents agrees with that expected from the solubility parameter concept, whereas the findings for ethers may be understandable by considering the role of the solvent molecules as donors in addition to the role as medium. The extraction constants in the inert solvent system are expected to be independent of the kind of solvent under desirable conditions of the aqueous phase; the values of $\log K_{ex}$ were found to be constant ($\log K_{ex} = -8.14 \pm 0.23$). The distribution ratios were compared with those of scandium tris-TTA chelate. In the inert solvent systems, the values of D_{Eu} are nearly proportional to those of D_{Sc}, $\log D_{Eu}(pA = 5.50) = 1.1 \log D_{Sc}(pA = 8.00) - 0.05$; on the other hand, the distribution ratio is much enhanced with a donor solvent and a semi-empirical relation, $\log D_{Eu}(pA = 5.50) = 1.3 \log D_{Sc}(pA = 8.00) + 2.98$, has been found in the ether solvent systems. The distribution ratios were also compared with those of uranyl bis-TTA chelate which trends to form a solvated complex; $\log D_{Eu}$ vs. $\log D_U$ plots are close to the straight line having a slope of 1.5 as expected. Some regularities found in this study may be useful for the selection of a suitable solvent or for the estimation of distribution ratio. (auth)

19538 FUNDAMENTAL RESEARCH FOR LIQUID–LIQUID EXTRACTION ACCOMPANIED BY REACTION. Nakashio, Fumiyuki (Kyushu Univ., Fukuoka). Kagaku Kogaku; 36: No. 6, 593-600(Jun 1972). (In Japanese).

Extraction of uranium nitrate by the use of tricresyl phosphate (TCP) and extraction of acetic acid by the use of N-laurylamine (LA-2) are discussed from the standpoint of extraction equilibrium theory. Prior to the measurement of extraction speed of the uranium nitrate into the TCP, the extraction equilibrium was measured. The association number ν of the TCP is 2 in the low concentration range of TCP, and 4 in the high concentration range, where ν was calculated according to the equation $\log m = \nu \log (TCP) + \text{const}$. An organic phase was dispersed into the aqueous phase in an extraction tower with a constant volume pump through a nozzle at a constant rate of flow, and collected into a drip-collecting burette. In measuring the extraction speed of acetic acid into the LA-2, the extraction equilibrium was measured using the solvents, n-hexane, CCl_4, $CHCl_3$, and MIBK. Results of the TCP experiments can be explained by a simple model based on one dimensional diffusion theory, while the LA-2 experimental results require further investigation. (Japan)

19539 SORPTION OF POLYVALENT ELEMENTS ON SILICA GEL. V. Separation of Macroamounts of Zirconium and Hafnium by Sorption on Silica Gel. Caletka, R.; Selucky, P. (Nuclear Research Inst., Rez, Czech.). Collect. Czech. Chem. Commun.; 37: No. 12, 4008-4015(Dec 1972).

Separation of gram amounts of zirconium from hafnium traces was studied using sorption on silica gel from hydrochloric acid solutions. The effects of the silica gel type used, of the hydrochloric acid concentration, of the concentration of the sorbed element, and of the temperature on the sorption of zirconium and hafnium were determined. A column with the effective height of 100 cm can be used for a one-step purification of 10 g of $ZrOCl_2 \cdot 8\ H_2O$/kg of silica gel. Optimum separation conditions were obtained with elution by 11.5 to 12M HCl at a flow rate of 1 ml cm^{-2} min^{-1} and with the specific surface area of silica gel of ~400 m^2/g. Under these conditions the content of hafnium in zirconium can be reduced from original 1% to about 10 ppM. (auth)

19540 EXTRACTION OF URANIUM(6) WITH CAPRIC ACID. Nakasuka, N.; Hirose, K.; Tanaka, M. (Nagoya Univ., Japan). J. Inorg. Nucl. Chem.; 35: No. 1, 265-269(Jan 1973).

Partition of uranium(VI) was carried out at 25°C between water and benzene containing capric acid in excess, the total concentration of uranium(VI) and that of capric acid being less than 3×10^{-3} M and 0.10 to 1.50 M, respectively. Under the experimental conditions there exist two monomeric uranyl caprates with different compositions in the organic phase: $UO_2R_2 2HR$ and $UO_2R_2 4HR$. Thus the extraction equilibria for uranium(VI) are described as follows: $UO_2^{2+} + 2(HR)_{2,0} \xrightarrow{K_{12}} (UO_2R_2 2HR)_0 + 2H^+$; $UO_2^{2+} + 3(HR)_{2,0} \xrightarrow{K_{14}} (UO_2R_2 4HR)_0 + 2H^+$ with the following extraction constants: $\log K_{12} = \log ([UO_2R_2 2HR]_0[H^+]^2[UO_2^{2+}]^{-1}[(HR)_2]_0^{-2})$; $\log K_{12} = -5.66 \pm 0.05$; $\log K_{14} = \log ([UO_2R_2 4HR]_0[H^+]^2[UO_2^{2+}]^{-1}[(HR)_2]_0^{-3})$; $\log K_{14} = -5.83 \pm 0.15$. The equilibrium for the uranyl caprates in the organic phase can be formulated as: $(UO_2R_2 2HR)_0 + (HR)_{2,0} \xrightarrow{K_f} (UO_2R_2 4HR)_0$ where $\log K_f = -0.17 \pm 0.10$. (auth)

19541 KINETICS OF THE ADSORPTION OF IODINE FROM AQUEOUS SOLUTIONS ON INDIVIDUAL CARBON GRAINS. Akhrimenko, V. E.; Poteryaev, A. V.; Ampilogov, I. E. (Kuban State Univ., Krasnodar, USSR). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 5, 726-727(May 1972).

Translated from Zh. Diz. Khim.; 46: No. 5, 1262-1264(May 1972).

An improved method for the investigation of the kinetics of the adsorption of substances in solution on an individual sorbent grain is described. The activation energies for internal diffusion determined by various methods were compared. (auth)

19542 MECHANISM OF THE SORPTION OF METAL IONS ON CARBOXYLIC ACID CATION-EXCHANGE RESINS. XII. The Formation of a Mixture of Uranyl Complexes of the Type $[M(A)_3]^-$ and $[M(A)_2]$. Yufryakova, N. K.; Chuveleva, E. A.; Nazarov, P. P.; Chmutov, K. V. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 5, 702-704(May 1972).

Translated from Zh. Fiz. Khim.; 46: No. 5, 1219-1222(May 1972).

The formation of a mixture of uranyl complexes of SG-1 resin, $[M(A)_2]$ and $[M(A_3]^-$, was investigated by potentiometric titration and by ir spectroscopy. The amount of the $[M(A)_3]^-$ complex in the resin diminishes as it is saturated by the metal and for the same degree of saturation depends on the concentration of uranium in the initial solution. The ratio of the peak intensities of the bands characterizing the vibrations of the different types of bonds between the carboxylate ion and uranium in the ir spectra of SG-1 resin containing uranium is largely determined by the stability of the complexes formed. (auth)

19543 SPREADING OF THE BANDS IN THE SEPARATION OF LANTHANIDES BY DISPLACEMENT CHROMATOGRAPHY IN THE PRESENCE OF COMPLEXONES. II. Effect of Temperature and Rate of Elution on the Spreading of the Bands. Sheptunov, V. N.; Maslova, G. B.; Nazarov, P. P.; Chmutov, K.V.P. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 5, 675-677(May 1972).

Translated from Zh. Fiz. Khim.; 46: No. 5, 1171-1173(May 1972).

The effect of temperature and rate of elution on the spreading of neodymium and cerium bands in the presence of diethylene-triaminepentaacetic acid (DTPA) was investigated. The heights equivalent to a theoretical plate were calculated from the elution curves on the basis of the countercurrent extraction theory and the Glueckauf plate theory at different temperatures and rates of elution. Comparison of the values of HETP obtained suggested a film mechanism of diffusion in the separation of neodymium and cerium with 0.025 M DTPA solution. (auth)

19544 SPREADING OF THE BANDS IN THE SEPARATION OF LANTHANIDE ELEMENTS BY DISPLACEMENT CHROMATOGRAPHY IN THE PRESENCE OF COMPLEXONES. III. Effect of Grain Size, Degree of Cross-linking of the Resin, and Eluent Concentration on the Spreading of the Bands. Sheptunov, V. N.; Maslova, G. B.; Nazarov, P. P.; Chmutov, K. V. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 5, 677-678(May 1972).

Translated from Zh. Fiz. Khim.; 46: No. 5, 1174-1176(May 1972).

The effect of grain size, degree of resin crosslinking, and eluent concentration on the spreading of the neodymium and cerium bands in the presence of diethylenetriaminepentaacetic acid (DTPA) was investigated. The effective heights of the theoretical plate (HETP) were calculated from the elution curves by Glueckauf's equation and the equation of the theory of countercurrent extraction. The study of the dependence of HETP on kinetic factors led to the conclusion that the rate-limiting stage in the displacement of neodymium and cerium by 0.025 M DTPA solution on KU-2 (2-8% divinylbenzene) resin is film diffusion. (auth)

19545 EQUILIBRIUM IN THE ION-EXCHANGE SORPTION OF ZIRCONIUM AND HAFNIUM FROM NITRIC ACID SOLUTIONS ON KU 2 CATION-EXCHANGE RESIN. Grinberg, A. N.; Vinarov, I. V. Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 5, 683-685 (May 1972).

Translated from Zh. Fiz. Khim.; 46: No. 5, 1185-1187(May 1972).

The equilibrium in the ion exchange sorption of zirconium and hafnium from nitric acid solutions on KU-2 cation exchange resin

in the hydrogen-form was investigated. The results obey Nikol'-skii's equation. The exchange constants for zirconium and hafnium were calculated. (auth)

19546 MECHANISM OF THE SORPTION OF METAL IONS ON COMPLEX FORMING RESINS. Chuveleva, E. A.; Yufryakova, N. K.; Nazarov, P. P.; Chmutov, K. V. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 5, 662-664(May 1972).

Translated from Zh. Fiz. Khim.; 46: No. 5, 1147-1150(May 1972).

The mechanism of the interaction of uranium(VI), neptunium(VI), plutonium(VI), mercury(II), indium(III), copper(II), nickel, calcium, and lanthanide ions with SG-1, KB-4, and KB-2 resins as well as with the KRF phosphonic acids resin was investigated by potentiometric titration, adsorption measurements, and infrared spectroscopy. (auth)

19547 CHROMATOGRAPHIC SEPARATION OF AMERICIUM AND THE LANTHANIDES WITH THE AID OF COMPLEXONES. Shepetyuk, L. V.; Matorina, N. N.; Safonova, N. D.; Chmutov, K. V. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 5, 666-668(May 1972).

Translated from Zh. Fiz. Khim.; 46: No. 5, 1154-1157(May 1972).

The optimum conditions for the separation of americium and europium by elution with aqueous diethylenetriaminepentaacetic acid at 85°C were calculated. Under these conditions, microamounts of americium and europium were separated chromatographically on KU-2 cation-exchange resin as well as americium and lanthanides at higher saturations of the cation exchanger by the lanthanide. (auth)

19548 DYNAMICS OF ION-EXCHANGE SORPTION IN THE PRESENCE OF COMPLEX-FORMING AGENTS. I. SELECTIVE ELUTION OF THE MACROCOMPONENT FOR A CONVEX SORPTION ISOTHERM. Matorina, N. N.; Buchatskii, P. M.; Chmutov, K. V. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 5, 668-670(May 1972).

Translated from Zh. Fiz. Khim.; 46: No. 5, 1158-1160(May 1972).

Selective elution with solutions of complex-forming agents under conditions of a convex sorption isotherm was investigated using as an example the separation of yttrium and cerium by solutions of diethylenetriaminepentaacetic acid. The possibility of calculating the conditions for the formation and the rate of migration of a steady-state front in such systems was demonstrated. When the rates of migration of the extracted component in the sorption and free layers of the resin are different, selective extraction under conditions of a convex sorption isotherm is accompanied by the contraction of the initial sorption band; on further migration of the extracted component a steady-state front is established in the free layer of the resin and the form of the band is determined by the sorption isotherm. (auth)

19549 CALCULATED AND EXPERIMENTAL DATA FOR THE ISOLATION OF LANTHANIDES BY DISPLACEMENT COMPLEX-FORMATION CHROMATOGRAPHY. Nazarov, P. P.; Sheptunov, V. N.; Maslova, G. B.; Chmutov, K. V. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 5, 670-671(May 1972).

Translated from Zh. Fiz. Khim.; 46: No. 5, 1161-1164(May 1972).

The compositions of the aqueous phase and the resin in the isolation of neodymium with the aid of diethylenetriaminepentaacetic acid were calculated at 25°C. There is satisfactory agreement between the calculated and experimental results. (auth)

19550 SORPTION OF URANYL IONS ON ANION-EXCHANGE RESINS SATURATED WITH ANIONIC LIGANDS. Eristavi, D. I.; Brouchek, F. I.; Eristavi, V. D.; (and others) (Georgian Polytechnic Inst., Tbilisi, USSR). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 5, 672-673(May 1972).

Translated from Zh. Fiz. Khim.; 46: No. 5, 1165-1167(May 1972).

The sorption of uranyl ions from aqueous solutions at pH 2.5 to 3 on anion exchangers in the fluoride-, carbonate-, and ethylenediaminetetraacetate-forms was confirmed by x-ray diffraction. A probable mechanism of the formation of anionic uranyl complexes in the anion-exchanger phase is proposed on the basis of an ir spectroscopic study. The dynamic sorption capacities of AN-2Fg, AV-16, and AV-17 resins with respect to uranium were determined by plotting the sorption output curves under different hydrodynamic conditions. The sorbents were arranged in series in terms of their efficiency in the systems investigated. (auth)

19551 SPREADING OF THE BANDS IN THE SEPARATION OF LANTHANIDES BY DISPLACEMENT CHROMATOGRAPHY IN THE PRESENCE OF COMPLEXONES. I. Effect of Temperature on the Separation Factors for the Lanthanides. Sheptunov, V. N.; Maslova, G. B.; Nazarov, P. P.; Sukhinina, N. A.; Chmutov, K. V. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 5, 674-675(May 1972).

Translated from Zh. Fiz. Khim.; 46: No. 5, 1168-1170(May 1972).

The Pr–Nd separation factors in the presence of nitrilotriacetic (NTA), diethylenetriaminepentaacetic acid (DTPA), and ethylenediaminetetraacetic acid (EDTA) were determined at 25 and 70°C and the Nd–Ce separation factors were determined in the presence of DTPA at 25, 50, 70, and 90°C. The calculated and experimental separation factors are fairly close for the lanthanide complexes of DTPA and EDTA. With increase of temperature, the separation factors of the lanthanides diminish in the presence of DTPA and EDTA and increase in the presence of NTA. (auth)

19552 HIGH SPEED-HIGH EFFICIENCY SEPARATION OF THE TRANSPLUTONIUM ELEMENTS BY EXTRACTION CHROMATOGRAPHY. Horwitz, E. P.; Bloomquist, C.A.A. (Argonne National Lab., IL). J. Inorg. Nucl. Chem.; 35: No. 1, 271-284 (Jan 1973).

The separation of various tripositive transplutonium elements by high efficiency extraction chromatographic columns using di(2-ethylhexyl)orthophosphoric acid (HDEHP) as the stationary phase was analyzed in terms of the resolution function. Resolution, R_s, for Bk(III)–Cf(III) system was studied as a function of column length and particle size of inert support. R_s vs v curves at different temperatures were calculated for Cm(III)/Am(III), Cf(III)/Bk(III), Fm(III)/Es(III) and Md(III)/Fm(III). The data were used to select conditions for high speed separations of Cm and Cf; Bk and Cf; Bk, Es, and Fm; and Es, Fm, and Md using high efficiency HDEHP columns. Very high resolution HDEHP columns containing over one thousand plates were also studied. The reproducibility and stability of HDEHP–Celite columns were studied as a function of particle size, liquid loading, temperature and flow velocity. (auth)

19553 SYNTHESIS OF NEW P-CONTAINING SORBENTS AND SCANDIUM SORBTION ON THEM. Shatskii, V. M.; Krivenko, S. V.; Komissarova, L. N.; Bebikh, G. F.; Prutkova, N. M.; Kesler, Ya. A.; Tvorogov, V. A. Vestn. Mosk. Univ., Ser. II. Khim.; 13: No. 6, 653-658(1972). (In Russian).

Optimal conditions for scandium sorption and separation from iron were specified using the method of experiment factorial design. A specific sorbent, which is the product of styrene copolymerization with divinyl benzene phosphorylated by ($PNCl_2$) and subsequently hydrolyzed by a potassium hydroxide–water–alcohol solution, was used in the process. Use of 0.1N sulfuric acid as the initial solution and 7% ammonium fluoride solution as a desorbent ensured practically complete (98 to 99%) separation of iron in a single sorption–desorption cycle. Repeated desorption by a fresh portion of the desorbent increased scandium yield up to 92%. (auth)

19554 SOVENT EXTRACTION OF ACTINIDE AND LANTHANIDE ELEMENTS BY AMMONIUM SALTS. I. Extraction of U, Np, and Pu from Solutions of Nitric and Hydrochloric Acids, by Cetyltrimethylammonium Bromide and Cetyltrimethylammonium Nitrate. Szeglowski, Z.; Gavrilov, K. A.; Kim Yun-Bon; Om San-Ik; Mikulski, J. (Joint Inst. for Nuclear Research, Dubna, USSR). Nukleonika; 17: No. 5-6, 293-299(1972). (In Russian).

Use of solutions of cetyltrimethylammonium bromide and cetyltrimethylammonium nitrate in chloroform and dichlorethane containing isoamyl alcohol for the extraction of U, Np, and Pu was studied. The solvation number for U(VI), Np(VI), Pu(VI), and Pu(IV) in solutions of nitric and hydrochloric acids was determined. (auth)

19555 SORPTION OF CERTAIN TRANSPLUTONIUM AND RARE EARTH ELEMENTS FROM CONCENTRATED SOLUTIONS OF HYDROCHLORIC ACID IN THE PRESENCE OF ALCOHOL ON A CATION-EXCHANGE RESIN. Guseva, L. I.; Tikhomirova, G. S. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 197-201(1972).

Translated from Radiokhimiya; 14: No. 2, 188-193(1972).

The sorption of Am, Cm, and Eu on cation exchange resins from aqueous alcohol solutions of hydrochloric acid was investigated as a function of the acid concentration, the nature and content of the alcohol in solution, as well as the content of divinylbenzene in the resin. The possibility of concentration of the transplutonium and rare earth elements from 2 to 6 N solutions of hydrochloric acid in the presence of more than 40% alcohol on cation exchange resins with a high content of DVB was indicated. For the group separation of the transplutonium and rare earth elements, it was proposed that 8 to 10 N solutions of HCl, containing 60 to 40% alcohol, respectively, be used instead of solutions with HCl concentration ≥ 12 N. For purposes of separation it is better to use cation exchange resins with a DVB

content of ~4%. The group separation of Am and Bk from Ce and Eu on the cation exchange resin Dowex-50 X4 with a solution of 10.5 N HCl in 40% C_2H_5OH and the separation of Am and Eu with a solution of 8 N HCl in 60% CH_3OH are presented. (auth)

19556 SORPTION AND SEPARATION OF CERTAIN TRANSPLUTONIUM AND RARE EARTH ELEMENTS ON A ZIRCONIUM PHOSPHATE SILICATE SORBENT. Barsukova, K. V.; Rodionova, G. N. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 237-240(1972).

Translated from Radiokhimiya; 14: No. 2, 228-231(1972).

The distribution coefficients of Am, Cm, U, Eu, and Ce on a zirconium phosphate–silicate sorbent were determined as a function of the nitric acid concentration and the time of establishment of equilibrium. A method was developed for the separation of berkelium and cerium in the tetravalent state from accompanying rare earth, transplutonium elements, and plutonium on a column of a zirconium phosphate–silicate sorbent in a mixture with lead dioxide with the aid of nitric acid of various concentrations. The influence of weighable amounts of impurities on the sorption of trace amounts of cerium was demonstrated. (auth)

19557 EXTRACTION SEPARATION OF THORIUM(IV) FROM SCANDIUM AND THE RARE EARTH ELEMENTS FROM NITRIC ACID MEDIA WITH 1,3,4,5,-TETRASUBSTITUTED PYRAZOLES. Dziomko, V. M.; Avilina, V. N.; Kon'kova, O. V.; Ivanov, O. V. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 251-255(1972).

Translated from Radiokhimiya; 14: No. 2, 241-245(1972).

The extraction of Th(IV), Sc(III), Tb(III), and Y(III), and trace amounts of promethium from nitric acid media was studied by the method of radiochemical monitoring. The results obtained show that in extraction from solutions of nitric acid (C = 0.1 to 10 M), selective extraction of thorium(IV) is observed. The use of 1-methyl-3, 5-di-n-butyl-4-n-propylpyrazole (MDBPP) in benzene as the extraction reagent permits separation of thorium from scandium and the rare earth elements by extraction from a mixture of 1 M HNO_3 and 10 M $LiNO_3$. The following separation factors were obtained: Th/Sc, Th/Tb, Th/Ce, Th/Y, corresponding to $\geq 1.0 \times 10^7$, $\geq 9.0 \times 10^6$, $\geq 5.7 \times 10^6$, $\geq 8.9 \times 10^6$. In order to separate thorium from the components of industrial chlorides of the rare earth elements and from the components of tin slag (Sc and others) in a solution of nitric acid and a salting out agent, extraction with a solution of MDBPP in benzene was used. (auth)

19558 INVESTIGATION OF THE COMPLEX FORMATION OF TRIVALENT ACTINIDE AND LANTHANIDE ELEMENTS BY THE METHOD OF ELECTROMIGRATION. XV. Ethylenediaminetetramethylphosphonic Acid. Shalinets, A. B. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 279-284(1972).

Translated from Radiokhimiya; 14: No. 2, 269-274(1972).

The complex formation of trivalent americium, curium, and cerium with ethylenediaminetetramethylphosphonic acid (EDTP) was investigated by the method of electromigration at $\mu = 0.1$ (KNO_3) and $t = 25 \pm 0.1$°C. The complex ions formed, $M(H_5A)$, $M(H_4A)$, $M(H_3A)$, $M(H_2A)$, M(HA), and MA, were identified, their general stability constants were determined, and the structure of the chelates formed was discussed. It was shown that EDTP can be used for the analytical separation of small (~0.05 g/liter) quantities of Am(III) and Cm(III). (auth)

19559 ELECTROCHROMATOGRAPHY OF RARE ELEMENTS. Use of Organic Acids in the Electrochromatographic Separation of Molybdenum(VI), Tungsten(VI), and Vanadium(V). Gaibarkyan, D. S.; Termendzhyan, Z. Z. (Erevan State Univ.). Arm. Khim. Zh.; 25: No. 1, 14-18(1972). (In Russian).

The separation of microgram quantities of MoO_4^{2-}, VO_3^-, and WO_4^{2-} ions from solutions of organic acids and their salts was shown to be possible by taking advantage of differences in the mobility of these ions in paper electrochromatography. Solutions of tartaric, citric, and oxalic acids and their salts proved to be strong, complex-forming agents in relation to Mo(VI), W(VI), and V(V) ions. For ion separation the most effective electrolyte was 0.01 M K tartrate, the ion mobility decreasing in the order W > Mo > V. (KSW)

Inorganic, Organic, and Physical Chemistry

Refer also to abstract 20231.

19560 METALLURGICAL CHEMISTRY. Proceedings of a Symposium Held in London, England, July 14–16, 1971. Kubaschewski, O. (ed.). London; Her Majesty's Stationary Office (1972). 693p. (CONF-710738–). £5.50.

From International Symposium on Metallurgical Chemistry; London, United Kingdom of Great Britain and Northern Ireland (UK) (14 Jul 1971).

Forty-three papers were presented in sections entitled: experimental methods, structure and stability (subsections on physical approach and chemical approach), thermochemical evaluation of phase boundaries and equilibrium diagrams, industrial applications, and data compilation and storage. Separate abstracts were prepared for six of the papers. (UK)

For abstracts of individual papers see: 19713, 19714, 20253, 20363, 20364, and 21549.

Chemical and Physicochemical Properties

Refer also to abstracts 19673, 19677, and 20248.

19561 (RD/B/N-2500) GENERAL EQUATION FOR THE SOLUBILITY OF OXYGEN IN LIQUID SODIUM. Addendum. Noden, J. D. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs). Dec 1972. 17p. Dep. NTIS. (U. S. Sales Only).

An earlier review (RD/B/R2146) on the solubility of oxygen in sodium has been updated. A correlation has been made of published data on the solubility of oxygen in liquid sodium using the least squares method. Selected analyses (268) from twelve different investigations were used to derive the solubility curve, described by the general equation $\log_{10}[O]_{wppm} = 6.2571 - [2444.5/T(°K)]$. This is in close agreement with the expression recommended by Eichelberger. (auth)

19562 STUDIES ON THE ELECTROREDUCTION OF BISMUTH(III) IN MOLTEN $LiF-BeF_2-ZrF_4$ BY VOLTAMMETRY AND CHRONOPOTENTIOMETRY. Hammond, J. S.; Manning, D. L. (Oak Ridge National Lab., TN). High Temp. Sci.; 5: No. 1, 50-55(Feb 1973).

The electroreduction of bismuth(III) in $LiF-BeF_2-ZrF_4$ at 500°C results in a one step reversible deposition of an insoluble product. An n value of 3 was obtained on different indicator electrode materials by voltammetric and chronopotentiometric techniques. A diffusion coefficient for the Bi(III) species of 1×10^{-6} cm^2/sec was evaluated. No evidence was observed of $Bi^{(3\pm n)}$ intermediate states in $LiF-BeF_2-ZrF_4$. Iridium appears to be a good choice for an indicator electrode both in terms of inertness and long-term surface reproducibility in the molten salt. (auth)

19563 HIGH-TEMPERATURE REACTIONS BETWEEN URANIUM DIOXIDE AND SILICON CARBIDE. Allen, G. C.; Crofts, J. A.; Swan, T. (Central Electricity Generating Board, Berkeley, Eng.). pp 630-639 of Reactivity of Solids. Anderson, J. S. (ed.), London; Chapman and Hall Ltd. (1972).

From 7th International Symposium on the Reactivity of Solids; Bristol, United Kingdom of Great Britain and Northern Ireland (UK) (17 Jul 1972). See CONF-720703-.

UO_2 and SiC react at a measurable rate above 1650°K evolving CO and SiO and forming $USi_{1.67}$, $U_3C_3Si_2$, SiC, and uranium carbide. A reaction mechanism is presented to explain these products. The kinetics were controlled by product gas removal whilst the temperature dependences of the kinetics were dominated by the thermodynamics of the equilibria involved rather than the diffusion. SiO and CO were evolved by separate equilibria and hence SiO evolution continued in the presence of a CO overpressure when the product was uranium carbide. (auth)

19564 ATTEMPT AT THE IDENTIFICATION OF THE DYNAMIC PROPERTIES OF THE ISOMERIZATION COLUMN ON THE BASIS OF THE RESULTS OF RADIOISOTOPE MEASUREMENTS. Bulinski, B.; Malinowski, K.; Michalik, A.; Nizegorodcew, P. (Inst. of Nuclear Techniques, Krakow). Isotopenpraxis; 8: No. 7, 261-265(Jul 1972).

An attempt was made to interpret tracer measurements by means of transfer functions. Previously obtained data on the residence time of the catalyst in the xylene isomerization column were used in the identification of dynamic properties of individual sections of the column. (auth)

19565 SELF-DIFFUSION IN NORMAL AND HEAVY WATER IN THE RANGE 1 TO 45°. Mills, R. (Australian National Univ., Canberra). J. Phys. Chem.; 77: No. 5, 685-688(1 Mar 1973).

Self-diffusion coefficients of tritiated water in normal (H_2O) and heavy water (D_2O) were measured over the temperature range 1 to 45°C. The diaphragm-cell technique was used and the results are considered to be probably accurate to ±0.2%. The data of Longsworth for HDO diffusion in both H_2O and D_2O in conjunction with the tritiated water values measured here were used to calculate the self-diffusion coefficients of pure normal water (H_2O-H_2O) and pure heavy water (D_2O-D_2O). These coefficients were tabulated and compared with molecular dynamics and NMR data. (auth)

Isotope Effects

Refer also to abstract 19716.

19566 PHOTODIMERIZATION OF SOME CYCLOPROPENES. DeBoer, C. D.; Wadsworth, D. H.; Perkins, W. C. (Eastman Kodak Co., Rochester, N.Y.). J. Amer. Chem. Soc.; 95: No. 3, 861-869(7 Feb 1973).

The photochemistry of three 1,2-diphenylcyclopropenes [methyl 1,2-diphenylcyclopropene-3-carboxylate(1), 1,2-diphenylcyclopropene(2), and 1,2,3-triphenylcyclopropene(3)] was studied. Direct irradiation gives no photodimers. Sensitized irradiation gives tricyclohexane dimers (major) and cyclopropylcyclopropenes (minor). The tricyclohexanes are thermally rearranged to 1,4-cyclohexadienes at widely varying temperatures. Quantum yield measurements and isotope effects show that the dimerization of 1 occurs in stepwise fashion with a diradical intermediate. Flash photolysis measurements show the triplet state of 1 is ≈60 kcal/mol. Nonvertical energy transfer to cyclopropenes appears to be unimportant. When low-energy sensitizers are used, the dimerization appears to include a thermolecular step and can only be explained by a process similar to the Schenck mechanism. Isotope effects studies were made of 3. (auth)

19567 FENTON'S REAGENT. II. Reactions of Carbonyl Compounds and α,β-Unsaturated Acids. Walling, Cheves; El-Taliawi, G. M. (Columbia Univ., New York). J. Amer. Chem. Soc.; 95: No. 3, 844-847(7 Feb 1973).

Carbonyl compounds such as acetone are readily attacked by hydroxyl radicals generated by the reaction of Fe^{2+} and H_2O_2, but the resulting carbonyl conjugated radicals are reduced to starting material by additional Fe^{2+}. As hydroxyl radical traps, they thus retard the oxidation of methanol, and rate constants for hydroxyl radical reactions derived from the competitive inhibition are in good agreement with those from radiation chemistry. Hydroxyl radicals add readily to the double bonds of α,β-unsaturated acids, and the resulting radicals are also reduced with a net addition of water; e.g., maleic acid is converted to malic acid. The acids inhibit alcohol oxidation by trapping both hydroxy and α-hydroxyalkyl radicals, the latter process providing an interesting possible synthesis of lactones. Comparison of results obtained for acetone and perdeuterioacetone indicates a large kinetic isotope effect, $K_{3\pi}(H)/K_{3\pi}(D) = 3.54$. (auth)

19568 MICROWAVE SPECTRUM AND STRUCTURE OF DIMETHYLAMINODIFLUOROPHOSPHINE, $PF_2N(CH_3)_2$. Forti, P.; Damiani, D.; Favero, P. G. (Univ., Bologna). J. Amer. Chem. Soc.; No. 3, 756-759(7 Feb 1973).

The microwave spectra of $PF_2N(CH_3)_2$ and $PF_2N(CD_3)_2$ were measured in the frequency range 8000 to 40,000 MHz. The values of the rotational and distortion constants (in MHz) obtained from the measured transitions for $PF_2N(CH_3)_2$ and $PF_2N(CD_3)_2$, respectively, are as follows: A, 4315.6 ± 2.7, 3748.8 ± 1.0; B, 2164.75 ± 0.01, 1940.08 ± 0.02; C, 2090.95 ± 0.01, 1803.41 ± 0.02; D_J, 0.0009019 ± 0.0000770, 0.0006047 ± 0.0001444; D_{JK}, 0.0006928 ± 0.0003480, 0.0002452 ± 0.0003766. The structural parameters consistent with the experimental data show that the molecule has a semiplanar structure in which phosphorus, nitrogen, and the two carbons lie in the same plane, which is the symmetry plane for the molecule in good agreement with the results of the x-ray analysis for such a molecule. No reasonable fitting of rotational constants has been found for a "gauche" conformation with a "short" P–N bond length and a PNC_2 angle lower than 175° in contrast with the electron diffraction results. (auth)

19569 MECHANISM OF 11-HYDROXYLATION OF LAURIC ACID BY RAT LIVER MICROSOMES. Bjoerkhem, I. (Karolinska Institutet, Stockholm). Biochem. Biophys. Res. Commun.; 50: No. 2, 581-587(23 Jan 1973).

11-$^2H_2$-Lauric acid with a randomly distributed tritium label was synthesized and the rate of 11-hydroxylation of this compound by rat liver microsomes was compared with the rate of 11-hydroxylation of 1-^{14}C-lauric acid. The 11-$^2H_2$-label was found to decrease the V_{max} of the reaction with a factor of about 3.6 and the K_m with a factor of about 1.5. The results support the previous suggestion that the rate-limiting step in microsomal 11-hydroxylation of lauric acid is the rate of cleavage of the C–H bond. (auth)

19570 CHLORINE QUADRUPOLE COUPLING IN METHYL CHLORIDE. Variation of Quadrupole Coupling Strength With Isotopic Substitution. Kukolich, S. G.; Nelson, A. C. (Massachusetts Inst. of Tech., Cambridge). J. Amer. Chem. Soc.; 95: No. 3, 680-682(7 Feb 1973).

High-resolution measurements of hyperfine structure on the J = 1 → 0 transitions in $CH_3{}^{35}Cl$ and $CH_3{}^{37}Cl$ were made using a molecular beam maser spectrometer. The measured ^{35}Cl quadrupole coupling strength is eqQ = 74,753 ± 2 kHz and spin-rotation constant C(^{35}Cl) = 2.4 ± 0.6 kHz. The measured ^{37}Cl quadrupole coupling strength is eqQ = 58.910 ± 2 kHz and spin-rotation constant C(^{37}Cl) = 1.4 ± 0.6 kHz. These results are compared with ^{35}Cl quadrupole coupling strengths obtained for CH_2DCl and CD_3Cl and a systematic decrease in ^{35}Cl quadrupole coupling is related to changes in the structure and properties of the methyl group on deuterium substitution. (auth)

19571 SPECTROSCOPY OF CF_3COZ COMPOUNDS. V. Vibrational Spectra and Structure of Solid Trifluoroacetic Acid. Berney, C. V. (Air Force Rocket Propulsion Lab., Edwards, CA). J. Amer. Chem. Soc.; 95: No. 3, 708-716(7 Feb 1973).

Infrared, Raman, and neutron-scattering data are correlated for solid CF_3COOH and CF_3COOD in the region 2000 to 200 cm^{-1}. Comparisons between liquid and solid CF_3COOH suggest that both phases are composed of hydrogen-bonded chains. Two possible structures are proposed, of which one (monoclinic, P2/m) is favored by the spectroscopic data. Vibrational assignment of CF_3COOH is straightforward, but that of CF_3COOD is more difficult; the normal modes in the region 910 to 610 cm^{-1} apparently change significantly on deuteration. Mixing between the O–D torsion and the O–C–O scissors mode implies a deviation from coplanarity of adjacent carboxyl groups. If this is actually the case, the symmetry of the (rigid) space group is reduced to P2. A solid–solid phase transition is observed at 220.5°K. Raman spectra taken above and below this temperature show only small frequency differences and suggest that the transition involves a change in the orientation or relative motion of adjacent carboxyl groups. (auth)

19572 ONE-PROTON CATALYSIS IN THE DEACETYLATION OF ACETYL-α-CHYMOTRYPSIN. Pollock, E.; Hogg, J. L.; Schowen, R. L. (Univ. of Kansas, Lawrence). J. Amer. Chem. Soc.; 95: No. 3, 968-969(7 Feb 1973).

The rate of deacetylation of acetyl-α-chymotrypsin decreases linearly with the atom fraction of deuterium (n) in mixtures of protium and deuterium oxides. Results show that one proton in the catalytic transition state produces the solvent isotope effect $k_{H_2O}/k_{D_2O} = 2.4$. Mechanisms involving multiple proton switches are thus excluded and any suspicion is removed that the moderate solvent isotope effects in these reactions might arise only from changes in protein or substrate hydration or other sources involving small alterations in the binding states of many protons. (auth)

19573 SOUND VELOCITY AND MOLECULAR STRUCTURE. VI. Sound velocity in deuterated compounds. Altenburg, K. (Zentralinstitut fuer Physikalische Chemie, Berlin). Z. Phys. Chem. (Leipzig); 250: No. 5-6, 399-401(1972). (In German).

Studies on sound velocity in deuterated and non-deuterated organic compounds and water showed that the velocity is lower in deuterated compounds and that the difference increases with increasing deuteration. (MCG)

19574 QUANTUM MECHANICAL STUDIES OF ATOMIC, BOND, AND MOLECULAR POLARIZABILITIES, SPECTROSCOPIC STUDIES OF VIBRATIONAL CONSTANTS, AND STATISTICAL THERMODYNAMICS: ISOTOPIC SPECIES OF CHLORINE DIOXIDE. Nagarajan, G.; Rajan, R. (Valdosta State Coll., GA). Z. Phys. Chem. (Leipzig); 250: No. 5-6, 329-344(1972).

The isotopic species of chlorine dioxide were briefly analyzed for the infrared absorption and Raman spectra, electronic band spectra, electron diffraction studies, and other spectroscopic investigations. Among the various quantum mechanical models, the delta-function potential model based on the variational method and delta-function electronic wave functions was employed to evaluate the atomic polarizabilities, the bond region, and nonbond region electron contributions to the bond parallel component of the polarizability, the bond perpendicular component of the polarizability, and the mean molecular polarizability of chlorine dioxide. On the basis of group theoretical considerations, the potential energy constants are evaluated by employing the four-constant valence force field. The Coriolis coupling coefficients are computed in terms of the symmetrized force constants. The mean-square amplitudes, and root-mean-square amplitudes for both bonded and nonbonded atom pairs are computed for the temperatures 298 and 500°K. On the basis of a rigid rotator and harmonic oscillator model, enthalpy function, free enthalpy function, entropy, and heat capacity are computed for the temperatures from 200 to 2000°K for both isotopic species of chlorine dioxide. The results are discussed in relation to the nature of the two characteristic bonds involved in this molecular system. (auth)

19575 RAMAN SPECTRA OF MOLECULAR CRYSTALS, LATTICE SPECTRA AND DYNAMICS OF ORTHORHOMBIC HYDROGEN AND DEUTERIUM HALIDES. Sun, T. S.; Anderson, A. (Univ. of Waterloo, Ont.). Chem. Phys. Lett.; 17: No. 1, 104-133 (1 Nov 1972).

Raman spectra of the lattice regions of polycrystalline hydrogen chloride, hydrogen bromide, deuterium chloride, and deuterium bromide at 79 and 18°K are reported. The lattice modes are assigned in accordance with the known crystal structures, and their frequencies compared with those obtained from calculations based on a simple intermolecular potential. (auth)

19576 HYDROGEN BOND STUDIES. 71. Ab initio calculation of the vibrational structure and equilibrium in HF_2^- and DF_2^-. Almloef, J. (Univ. of Uppsala). Chem. Phys. Lett.; 17: No. 1, 49-52(1 Nov 1972).

MO LCAO SCF calculations were performed to investigate the molecular structure and vibrational spectrum of the bifluoride ion in its normal and deuterated form. The potential energy for nuclear motions was evaluated as a function of the molecular degrees of freedom, taking only linear geometries into account. The vibrational Schroedinger equation was solved by expanding the vibrational part of the total wave function as a sum of products of linear harmonic-oscillator eigenfunctions. The calculated properties are in good agreement with experiments, and even the minute effects of deuteration are well reproduced. (auth)

19577 STUDY OF MECHANISM FOR THE FORMOLYSIS OF A 20α-TOSYLOXY STEROID. Deshmane, S. S.; Hirschmann, H. (Case Western Reserve Univ., Cleveland). J. Org. Chem.; 38: No. 4, 748-754(23 Feb 1973).

The mechanism of the formolysis of 3β-acetoxy-5α-pregnan-20α-yl p-toluenesulfonate (1b) was studied with preparations containing deuterium or tritium in the 17α position. The isotopic atom was retained in the formation of 17β-methyl-18-nor-5α, 17α-pregn-13-en-3β-yl acetate (2b). Neither of the two geometric isomers of the 5α-pregn-17-en-3β-yl acetate (7b,8b), therefore, is an intermediate in this reaction, although both are readily converted to this product (2b). The rate ratios, k_H/k_T, for the disappearance of the tosylate ester 1b and for the formation of its major formolysis products were determined. The isotope effect on the rate of formolysis was higher than expected for the formation of a C-20 cation. This could be due to an accompanying 17-hydrogen-assisted formolysis yielding at least some of 2b or due to a high rate of return from the ion pair. The latter explanation seems less likely. The unexpected formation of a uranediol derivative (4b) in this and a similar reaction which tentatively had been attributed by us and others to a two-step mechanism that included a methyl shift does not take this course because the deuterium that was located at C-17 in the starting compound was found at C-17a in the product 4b. A different mechanism, analogous to a postulate made by Eschenmoser, et al., for the biosynthesis of various steroids, is considered. (auth)

19578 STATES AND ISOTOPE EFFECTS IN THE PROTON TRANSFER REACTIONS OF METHYL 4-NITROVALERATE. Wilson, H.; Caldwell, J. D.; Lewis, E. S. (Rice Univ., Houston, TX). J. Org. Chem.; 38: No. 3, 564-566(9 Feb 1973).

The rates of proton transfer from methyl 4-nitrovalerate to pyridine and 2,4,6-trimethylpyridine were measured by iodination and by racemization. The iodination rates closely resemble those for 2-nitropropane, except for a larger term for solvent catalysis. Rates from racemization and iodination are the same where both can be measured, but iodination becomes less useful as the rate drops, and is least valuable in the dilute solutions necessary for water solutions. The deuterium isotope effect for the racemization of methyl 4-nitrovalerate-4-d by 2,4,6-trimethylpyridine is in the excess of 20 at 30°C. (auth)

19579 KINETIC PREFERENCE BETWEEN THE DIASTEREOTOPIC HYDROGENS IN THE LITHIATION OF BENZYL METHYL AND BENZYL TERT-BUTYL SULFOXIDES. Viayu, R.; Durst, T. (Univ. of Ottawa). J. Amer. Chem. Soc.; 95: No. 4, 1346-1347. (21 Feb 1973).

The kinetic preference for the removal of the diastereotopic hydrogens in benzyl methyl sulfoxide was determined. The isotope effect was found to be 2.5 ± 0.4 and the selectivity factor 1.7 ± 0.3. When a similar reaction was carried out on S,S,α-deuteriobenzyl tert-butyl sulfoxide, the kinetic selectivity for the removal of the pro-S vs. the pro-R hydrogen was calculated to be 117 ± 20 (assuming the same isotope effect as for benzyl methyl sulfoxide). At −60°C this represents a free energy difference of 2.17 kcal/mol between the two transition states. (DHM)

19580 MILLIMETER WAVE SPECTRA OF POTASSIUM HYDROXIDE: KOH AND KOD. Pearson, E. F.; Trueblood, M. B. (Southern Illinois Univ., Carbondale). J. Chem. Phys.; 58: No. 2, 826(15 Jan 1973).

Millimeter wave rotational transitions in the vibrational ground state of KOH and KOD are reported. Values for the ground state molecular constants are also given. (MCG)

19581 PHONONS IN DISORDERED MOLECULAR SOLIDS: RAMAN SPECTRA OF HEAVILY DOPED MIXED CRYSTALS OF BENZENE AND PERDEUTEROBENZENE. Hong, H. K.; Kopelman, R. (Univ. of Michigan, Ann Arbor). J. Chem. Phys.; 58: No. 1, 384-391(1 Jan 1973).

Raman spectra of mixed crystals of benzene-h_6 and benzene-d_6 were studied throughout the whole concentration range (0 to 100%). They are discussed in the virtual crystal limit, suitable for small trap depths. It is shown that within this limit: (1) all the phonons are delocalized in mixed crystals; (2) k-designation is still valid, and (3) no appreciable broadening is expected in mixed crystals. In particular, because the trap depths are the same for all three rotations in benzene mixed crystals, it is further inferred that: (1) there is a one-to-one correspondence between the mixed crystal absorption and the pure crystal absorption; (2) spectral line positions depend on the concentration linearly; and (3) the normal coordinates in the mass (or moment of inertia)-weighted coordinates remain unchanged from benzene-h_6 to mixed crystals to benzene-d_6. All these conclusions are supported by the experimental data. More general cases, where trap depths are different for different degrees of freedom, are also discussed. Implications of the phonon delocalization in isotopic mixed crystals to the interpretation of phonon sidebands of electronic spectra of isotopic mixed crystals are also pointed out. (auth)

19582 ZERO-POINT AVERAGE STRUCTURE OF A MOLECULE CONTAINING TWO SYMMETRIC INTERNAL ROTORS. Acetone. Iijima, T. (Hokkaido Univ., Sapporo). Bull. Chem. Soc. Jap.; 45: No. 12, 3526-3530(Dec 1972).

The theory of vibrational correction to the observed moments of inertia of a molecule which contains an internal rotor was extended to the case of two symmetric internal rotors, and applied to the analysis of the structure of acetone. The zero-point average structure was determined by using the moments of inertia obtained by microwave spectroscopy and the bond distances from gas electron diffraction. The zero-point average parameters were determined as follows: C−C 1.517 ± 0.003 Å; C = O 1.210 ± 0.004 Å; C−H 1.091 ± 0.003 Å; ∠HCH 108° 30′ ± 30′; ∠CCC 116° 0′ ± 15′. The isotope effects in the structure parameters were also observed in terms of the increase caused by deuteration to be δ(DCD) + 10′ ± 12′; δ(CCC) − 17′ ± 2′. The tilt angle of the methyl top was determined to be 2° 0′ ± 30′. (auth)

19583 THERMAL ISOTOPE EFFECTS IN THE MASS SPECTRA OF ORDINARY AND DEUTERIATED HYDROCARBONS. Komarov, V. N.; Tikhomirov, M. V. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 5, 766-767(May 1972).

Translated from Zh. Fiz. Khim.; 46: No. 5, 1329(May 1972).

The dependence of the mass spectra of CH_4, CD_4, C_3H_8, and C_3D_8 on the temperature of the ionization chamber (from 200° to 800°C) was investigated on an MI-1303 mass spectrometer with a high temperature source under the following conditions: accelerating potential of 2 kV, energy of electrons 70 eV, total electron emission 0.5 mA. It has been shown that the thermal coefficients of the intensities ΔI/DT of the molecular and certain fragment ions are different for the ordinary and the corresponding deuteriated compounds. It is suggested that these effects are due to the different excitation energies of the isotopes at the same temperatures. (auth)

19584 VIBRATIONAL SPECTROSCOPICAL STUDIES ON THE HYDRATES OF LiCl. Manewa, M.; Fritz, H. P. (Technische Univ., Munich). Z. Anorg. Allg. Chem.; 392: No. 3, 227-236(Oct 1972). (In German).

The entire infrared spectra and some Raman data of $LiCl \cdot nH_2O$ (n = 1, 2, and 3) are reported and discussed in terms of a dominant structure of the water molecules in the lattice. Characteristic vibrational frequencies of H_2O, DHO, and D_2O are compared. (MCG)

19585 STUDIES ON NITROGEN IODINE COMPOUNDS. VII. The ir Spectrum of Nitrogen Triiodide-1 Ammonia in the Range of N-I Fundamental Vibrations and the Valence Force Constants of the N-I Bonds. Knuth, Klaus (Univ., Heidelberg); Jander, Jochen; Engelhardt, Udo. Z. Anorg. Allg. Chem.; 392: No. 3, 279-286(Oct 1972). (In German).

New infrared spectra in the region 33 to 600 cm^{-1} of $^{14}NI_3 \cdot {}^{14}NH_3$, $^{15}NI_3 \cdot {}^{15}NH_3$ and $^{14}NI_3 \cdot$ pyridine, respectively, have been obtained. In addition, the infrared spectrum of $^{14}NI_3 \cdot {}^{14}ND_3$, which was prepared for the first time, was obtained. All absorption frequencies can be coordinated on the ground of the molecule model for the NI_3 scaffold with 5 atoms Z_2XY_2 of the symmetry C_{2v}, which was proved by x-ray examination. A set of force constants was calculated by approximation. The various nitrogeniodine valence force constants are discussed. (auth)

19586 FAR INFRARED SPECTRA OF BIS(AMINOACIDATO) COPPER(II) COMPLEXES: ASSIGNMENT OF COPPER LIGAND VIBRATIONS BY ISOTOPIC SUBSTITUTION. Canham, G. W. R.; Lever, A. B. P. (York Univ., Toronto). Spectrosc. Lett.; 6: No. 2, 109-114(1973).

Application of isotopic substitution with ^{65}Cu to the study of the far infrared spectra of bis(L-aminoacidato)copper(II) complexes revealed that metal sensitive vibrations lie at ca. 380 and ca. 330 cm^{-1}. They are tentatively assigned as $\nu(Cu-N)$ and $\nu(Cu-O)$ respectively. The shift in the spectra on substitution of ^{65}Cu for natural copper is discussed. (auth)

19587 EXCITATION FUNCTIONS AND ISOTOPE EFFECTS OF SOME SIMPLE ION MOLECULE REACTIONS: $X^+ + H_2$ AND $H_2^+ + X$. Fennelly, P. F. Waltham, MA; Brandeis Univ. (1972). 207p. University Microfilms Order No. 72-32,095.

Thesis (Ph.D.).

Excitation functions and isotope effects in simple reactions of the type $X^+ + H_2$ and $H_2^+ + X$ were measured in order to test the predictions of several models for ion-molecule reactions. The reactions $Ar^+ + H_2$ (D_2, HD) → $ArH^+ + H$ were studied. The data do not support the validity of the Spectator Stripping model. Recent trajectory calculations provide a better description of the data; this is of interest because of the simplicity of the model used in these calculations. An unusual isotope effect was found in the endothermic reaction $C^+ + HD \rightleftharpoons \begin{matrix} CH^+ + D \\ CD^+ + H \end{matrix}$ In the range of relative energies of approximately 1 to 7 eV, there is approximately a 35% preference for formation of the CD^+ product ion. At relative energies greater than 8 eV the CH^+/CD^+ ratio is greater than one and increases with increasing energy. This isotope effect is not in agreement with the predictions of phase space theory. It also does not agree with the interpretation of angular and velocity distributions of CD^+ product ions from the analogous reaction $C^+ + D_2$ as indicating this reaction proceeds through an intermediate complex at low energy with a transition to a direct mechanism at high energies. The occurrence of such an isotope effect indicates that caution must be exercised in making mechanistic interpretations from velocity and angular distributions of product ions. (DHM)

Isotope Exchange and Isotope Separation

Refer also to abstracts 19451, 19664, 19760, and 20187.

19588 (ORNL-tr-2671) CHEMICAL PURIFICATION AND CONVERSION OF ELECTROMAGNETICALLY SEPARATED ISOTOPES OF CADMIUM. Kellner, K. Translated by L. T. Newman (Oak Ridge National Lab., TN), from Isotopenpraxis; 8: 22-25(1972). 8p. Dep. NTIS.

The chemical purification of the cadmium isotopes which are collected, along with a number of foreign elements, in the pockets of an electromagnetic isotope separator is described. The chemical processing of the sample for mass spectrometric isotopic analysis and the preparation of cadmium isotopes in metallic form are outlined. (auth)

19589 STUDIES ON THE ISOTOPE EXCHANGE BETWEEN A MONOLAYER DEPOSITED ON NOBLE METAL SURFACES AND AQUEOUS SOLUTIONS. IV. Effect of the Electrode Potential on the Heterogeneous Isotope Exchange Kinetics. Miller, J.; Toth, G. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). Magy. Kem. Foly.; 78: No. 11, 588-591(Nov 1972). (In Hungarian).

The effect of the electrode potential and I_3^- concentration on the kinetics of the heterogeneous isotope exchange between an iodine monolayer chemisorbed by a smooth platinum surface and iodine contained in aqueous solutions was investigated. The reversible I^-/I_2 redox system itself was applied for the preparation of solutions with a constant I_3^- concentration and varying potentials and, inversely, with a constant potential and varying I_3^- concentrations. In the case of stabilized potential, the isotope exchange rate remained and unambiguous function of the I_3^- concentration. On the contrary, the exchange rate proved to be independent of the potential until it diminished to +450 to +500 mV. Under this potential-range, a partial desorption superimposing on the exchange reaction took place. (auth)

19590 INVESTIGATION OF ISOTOPIC EXCHANGE PROCESSES OCCURRING BETWEEN A MONOLAYER ON A NOBLE METAL AND AQUEOUS SOLUTIONS. III. Determination of the Activation Energy of the Isotopic Exchange Between Iodine Adsorbed on Platinum and Triiodide Ions. Toth, G.; Miller, J. (Magyar Tudomanyos Akademia Izotop Intezete, Budapest). Magy. Kem. Foly.; 78: No. 10, 523-526(Oct 1972). (In Hungarian).

The minimum activation energy of the heterogeneous isotopic exchange of ^{131}I between an iodine monolayer formed on a platinum surface and an aqueous solution of I_3^- ions was determined by measuring the time dependence of the fraction exchange at various temperatures. The value calculated for $E^*_{min.}$ is 2800 cal/mole. (auth)

19591 MECHANISM OF THE BASE-CATALYZED PROTOTROPIC PROPARGYLIC REARRANGEMENT IN VICINAL DIAMINES. Wotiz, J. H.; Barelski, P. M.; Koster, D. F. (Southern Illinois Univ., Carbondale). J. Org. Chem.; 38: No. 3, 489-493 (9 Feb 1973).

The relative rates of rearrangement of 3-hexyne with a strong base in various amines were ascertained, and vicinal diamines, particularly ethylenediamine (EDA), were found to be the most effective solvents. A concerted mechanism involving the EDA anion and the propargyl group in a nine-membered ring transition state is suggested. Since, in the presence of EDA-d_4, the rate of deuterium incorporation into the rearranged products parallels closely the rate of rearrangement, an intramolecular hydrogen transfer is not likely the preferred reaction path. (auth)

19592 FAVORSKII REARRANGEMENTS. VIII. EFFECTS OF METHYL SUBSTITUTION AND A TEST FOR INTERNAL RETURN FROM ENOLATE IONS. Bordwell, F. G.; Almy, J. (Northwestern Univ., Evanston, IL). J. Org. Chem.; 38: No. 3, 575-579 (9 Feb 1973).

Tertiary bromide (or chloride) $C_6H_5CH_2COCMe_2X$ (5) reacted with 0.05M NaOMe to give principally $C_6H_5CH_2COCMe_2OMe$ (8) plus a small yield of $C_6H_5CH_2CMe_2CO_2Me$ (9). With 1M NaOMe the percent of Favorskii ester (9) increased at the expense of α-methoxy ketone (8). The isomeric chloride $C_6H_5CHClCOCHMe_2$ (6) also gave 8 as the major product (plus minor amounts of 9) with 0.05M NaOMe, and again the formation of 9 was favored by increasing the methoxide concentration. On the other hand, bromide 6 gave principally $C_6H_5CHOHCOCHMe_2$ (presumably via an α-methoxyoxirane intermediate) and only small amounts of 8 and 9. Rate studies showed that the rate of formation of 9 from chloride 6 and bromide 6 were identical, within experimental error. This contrasts with the results from the $C_6H_5CMeXCOCH_3$ system where $k^{Br}/k^{Cl} = 105$. Mechanistic interpretations are given. The rate of deuterium exchange for $C_6H_5CH_2COCHMe_2$ corresponded closely enough to the rate of halide loss from $C_6H_5CHXCOCHMe_2$ to show that little or no internal return occurs to the $C_6H_5CH_2(O^-)=CMe_2$ enolate ion during deuterium exchange in methanol. (auth)

19593 ELECTROPHILIC SUBSTITUTION AT SATURATED CARBON. LI. Varieties of Pathways for Substituted-Ammonium Carbanide Ion Pairs to Reorganize. Almy, J.; Hoffman, D. H.; Chu, K. C.; Cram, D. J. (Univ. of California, Los Angeles). J. Amer. Chem. Soc.; 95: No. 4, 1185-1190(21 Feb 1973).

The stereochemical capabilities in tert-butyl alcohol of tertiary substituted-ammonium 3-tert-butyl-1-methylindenyl ion pairs were examined. Changes in charge distribution in protonated tertiary amine change the fate of the ion pair. Treatment of (−)-(R)-3-tert-butyl-1-deuterio-1-methylindene ((−)-1-d) in tert-butyl alcohol-O-h (ROH) with triethylenediamine (TDA) or pentamethylguanidine (PMG) gave several reactions. Hydriodides of the tertiary bases were present in representative runs. Careful kinetics were studied for PMG-catalyzed isomerization of 1 to 2 and of racemization of equilibrated (−)-1-h and (+)-2-h in ROH. The results suggested the following conclusions. (1) For 1-h in ROD, the rate of isomerization exceeds that of racemization of the system by factors of 24 to 53 with the charge-delocalizing base (PMG), but by a factor of 4×10^4 with the charge-localizing base (TDA). (2) For 1-h and 2-h in ROD, PMG produced a dominant isoinversion component, whereas TDA produced a less dominant isoinversion component. (3) The isoinversion components were demonstrated to be due neither to a carbanion–carbon acid proton transfer nor to concerted thermal isomerizations with PMG as base. (4) The suprafacial, base-catalyzed isomerization reaction of (−)-1-h to (+)-2-h occurs by a conducted tour mechanism by the amine of the proton along the π face of the anion from the 1 to the 3 position, where collapse to the covalent state occurs. (5) The slower isoinversion reaction (antarafacial, intramolecular proton transfer) passes through a relatively nonstructured, achiral contact ion pair of higher energy than the structured ion pair of the conducted tour mechanism. (6) The dominant isotope effects of the system are in collapse of contact ion pairs to 2, and in isotopic drowning of the amine's conjugate acid in the medium. (auth)

19594 HYDROGEN–DEUTERIUM EXCHANGE OF N-METHYLPYRIDINIUM ION IN METHANOL CONTAINING AMINES. Identity of the Catalyzing Base. Zoltewicz, J. A.; Cantwell, V. W.

(Univ. of Florida, Gainesville). J. Org. Chem.; 38: No. 4, 829-830(23 Feb 1973).

Evidence is presented that the base catalyst in the H–D exchange reaction of N-methylpyridinium ion at the 2,6-positions in methanol-O-d containing amines is methoxide ion and that the amine does not catalyze the reaction. (DHM)

19595 MECHANISM OF METAL ION PROMOTED HYDROGEN EXCHANGE REACTIONS. Magnesium(II) and Acetonyl Phosphonate. Kluger, R.; Wasserstein, P. (Univ. of Chicago). J. Amer. Chem. Soc.; 95: No. 4, 1071-1074(21 Feb 1973).

Acetonyl phosphonate (1), an analog of acetyl phosphate and of acetoacetate, was prepared and the rate of deuteration of the 2 position determined for a 0.2 M solution of substrate from pD 5.0 to 12.1 in the absence of magnesium ion and from pD 5.0 to 10.0 in the presence of 0.2 M magnesium ion. All rates were measured at 35 ± 1° by NMR methods. Effects of substrate and metal ion concentration on rates of exchange were determined, and these data together with the pD-rate profiles were used to determine apparent rate constants for specific processes. A table summarizing these rate constants is presented. The reaction whose rate is proportional to deuteroxide concentration has an apparent second-order rate constant that is over 2000 times larger in the presence of magnesium ion. Data from spectral studies are presented which indicate that acetonyl phosphonate has a high affinity for magnesium ion, that rate enhancements are not due to specific chelation of magnesium by the enolate ion of the substrate, and that acetonyl phosphonate coordinates as a bidentate (carbonyl–phosphoryl) ligand. Possible mechanisms for the metal-promoted proton exchange reaction are discussed. (auth)

19596 IDENTIFICATION OF RATE-CONTROLLING STEPS FOR THE WATER–GAS SHIFT REACTION OVER AN IRON OXIDE CATALYST. Oki, S. (Utsunomiya Univ., Japan); Mezaki, R. J. Phys. Chem.; 77: No. 4, 447-452(15 Feb 1973).

The mechanistic study of the water–gas shift reaction was performed utilizing the hydrogen–deuterium equilibration reaction which occurs simultaneously during the course of the water–gas shift reaction. Reaction temperatures ranged from 467 to 522°C and the total pressure of reaction system was 80 mm. The catalyst employed was an iron oxide. It was observed that the atomic fraction of deuterium in the total hydrogen adsorbed by the catalyst coincides with the atomic fraction of deuterium of water. Material balance equations of hydrogen and deuterium provided the estimates of the free energy changes of steps $2H(a) \rightleftharpoons H_2$ and $CO \rightleftharpoons CO(a)$. These estimates were in good agreement, indicating that, on certain assumptions, these steps are rate-controlling. In addition, the free energy change of hydrogen-exchange path also agrees with that of the associative desorption of hydrogen. The results obtained verify conclusions drawn from the previous mechanistic investigations of the water–gas shift reaction. (auth)

19597 PERDEUTERIATED ORGANIC COMPOUNDS. 1. Normal Long-Chain Saturated Deuteriocarbons, Monocarboxylic Acids, and Methyl Esters. Dinh-Nguyen, N.; Raal, A.; Stenhagen, E. (Univ., Goteborg). Chem. Scr.; 2: No. 4, 171-178(1972).

A convenient method for the synthesis of organic compounds of high deuterium content, over 99%, is described. It consists of hydrogen–deuterium exchange performed by incubation of undeuteriated organic compounds in heavy water in the presence of a homogeneous (alkali) catalyst and a heterogeneous catalyst belonging to the platinum metal group together with a peroxide promoter. (auth)

19598 SOME PECULIARITIES OF ISOTOPIC EXCHANGE REACTIONS WITH BENGAL ROSE. Stanko, V. I.; Iroshnikova, N. G. Isotopenpraxis; 8: No. 7, 252-258(Jul 1972). (In Russian).

Some peculiarities of isotopic exchange reactions between Bengal Rose (tetrachlorotetraiodofluorescein) and iodine monochloride were investigated. It was found that the maximum radiochemical yield of the reaction is obtained in a phosphate buffer with room temperature and pH ranging between 5.9 and 6.5 during a 10 min time. It was found that the inverse isotopic exchange of I-131 labeled Bengal Rose is possible with iodine monochloride only, temperature and pH values being as indicated above. The assumption is expressed that the reaction involving introduction of iodine isotopes into Bengal Rose by means of isotopic exchange is of the electrophilic type. (auth)

19599 STUDY OF GAS CHROMATOGRAPHIC DEUTERIUM EXCHANGE. Jancso, G.; Sztefanova, A. (Central Research Inst. for Physics, Budapest). Isotopenpraxis; 8: No. 7, 259-261 (Jul 1972).

The dependence of the gas chromatographic deuterium exchange on sample size, the amount of stationary phase, column diameter, and repeated passage of the sample through the column was investigated. Acetylacetone was used for the investigations. A study of deuterization of the column was also carried out. The results obtained may be useful in selecting optimal parameters for gas chromatographic deuterization of organic compounds. (auth)

19600 CONTRIBUTION TO THE STUDY OF THE ISOTOPIC EXCHANGE OF TRITIUM IN PHENOL AT HIGH TEMPERATURE. Bettens, B.; Dubois, E. (Univ., Brussels). J. Label. Compounds; 8: No. 3, 379-396(1972). (In French).

The experimental determination of the exchange rate, first between the tritium fixed on the OH function and the hydrogen of the nucleus, and then between the tritium specifically fixed on the cycle and the OH function was studied. The experimental results are obtained by two different ways, the lyophilization and the transformation in the corresponding phenolate. By means of the experimental values the activation energy of the exchange was calculated. With these values, it is possible to show that: a) due to its stability, the molecule can be used as tracer at high temperature in the gaseous phase. b) the compounds with labile hydrogen have a certain catalytic effect on the isotopic exchange. (auth)

Feed Materials Processing

19601 PROCESS FOR LEACHING BASE ELEMENTS, SUCH AS URANIUM ORE, IN SITU. Hard, R. A.; Ripley, R. L. (to Union Carbide Corp.). U. S. Patent 3,708,206. 2 Jan 1973. Filed date 20 Jul 1970. 10p.

This invention relates to a process for leaching base elements, such as uranium values, from an underground water saturated ore deposit containing oxidizable materials such as sulfides, carbon, and the like. An oxygen-bearing gas is introduced into the ore deposit prior to or simultaneously with a leach solution to oxidize the base elements within the ore deposit to a soluble state where they can then be dissolved in the leach solution. The pregnant solution is then withdrawn and treated by conventional techniques to remove the base elements. (Official Gazette)

Radiation Chemistry

Refer also to abstracts 19660, 19663, 19666, 19687, 20000, 21495, and 21515.

19602 (BMBW-FBK-72-24) RADIATION-INITIATED HYDROESTERIFICATION OF OLEFINS IN PRESENCE OF METAL CARBONYLS AS CATALYSTS. Saus, A.; Masoji, S. (Technische Hochschule, Aachen (West Germany). Institut fuer Technische Chemie und Petrolchemie). Dec 1972. 27p. (In German). Dep. NTIS. (U. S. Sales Only).

The cobalt carbonyl catalyzed hydroesterification of olefins with carbon monoxide and methanol gives high yields of alkanoic methyl esters using pressures of 75 to 250 atm and temperatures of up to 100°C in the presence of γ rays from a ^{60}Co (3×10^6 rad) source. Using n-octene-1 or a mixture of n-octene isomers a conversion of 92% of the n-octene-1 was achieved at 75 atm and 100°C (61% without irradiation). The reaction product was an isomeric mixture containing 99% of octyl methanoate (95% without irradiation) which is equivalent to an ester yield of 91% (58% without irradiation). The isomeric mixture of octyl methanoate consisted approximately of 70% octylmethanoate-(1), 20% -(2), 6% -(3) and 4% -(4) independent of the reaction conditions used. The use of increased radiation doses results in higher yields without an influence on the composition of the mixture of esters. (auth)

19603 (BNL-tr-523) CAPTURE REACTION AND ELECTRON RECOMBINATION IN LIQUID CYCLOHEXANE. Yakovlev, B. S.; Boriev, I. A.; Novikova, L. I.; Frankevich, E. L. Translated by S. J. Amoretty (Brookhaven National Lab., Upton, NY), from Int. J. Radiat. Phys. Chem.; 4: 395-404(1972). 19p. Dep. NTIS.

The electron-pulse radiation-induced conductivity of aromatic hydrocarbon solutions in cyclohexane and its dependence on the concentration and time are investigated. A current I_e due to electron conductivity is revealed at a concentration of solute [A] less than 10^{-5} mol dm^{-3}. The dependence of I_e on [A] and known values of electron and ion mobilities in cyclohexane lead to rate constants for electron capture by [A] of $(2.1 \pm 0.4) \times 10^{12}$ and $(2.3 \pm 0.4) \times 10^{12}$ dm^3 mol^{-1} s^{-1} for pyrene and diphenyl, respectively. The electron and positive ion recombination rate constants are shown to be close to theoretical values for diffusion-controlled recombination. (auth)

19604 (FRNC-TH-257) GRAFTING ONTO POLYETHYLENE AND ETHYLENE–PROPYLENE COPOLYMER USING RADIOCHEMICAL METHODS. Leca, J. P. (Paris Univ., Orsay (France)). 1971. 97p. (In French). NTIS (U. S. Sales Only).

Thesis.

The grafting of acrylonitrile onto polyethylene and ethylene–propylene copolymers that have been pre-irradiated in air was studied. The grafting process is initiated by the thermal decomposition of the peroxides formed in the presence of air. This grafting method also enables the radiochemical peroxidation reaction undergone by these polymers to be studied. The effects of pre-irradiation temperature, heating time, dose rate, and irradiation temperature were considered. It is shown that the radiochemical peroxidation of polyethylene and ethylene–propylene copolymers can be interpreted by a chain hydroperoxidation process. In the case of ethylene–propylene copolymers, this chain reaction only exists when these polymers are irradiated at a temperature higher than their vitreous transition temperature. In the case of polyethylene, the reaction chain can only develop at temperatures very much higher than the vitreous transition temperature (competition between propagation and termination reactions). (France)

19605 (JAERI-M-4889) HEAT TRANSFER ANALYSIS IN THE TWO TYPES OF AGITATED MOVING BED REACTOR FOR GAS-PHASE GRAFT POLYMERIZATION OF BUTADIENE ONTO THE POLYVINYL CHLORIDE POWDER. Yoshida, K.; Oomichi, H.; Suzuki, K.; Sekiguchi, A.; Yamashita, Y. (Japan Atomic Energy Research Inst., Tokyo). Jul 1972. 83p. (In Japanese). NTIS (U. S. Sales Only).

The heat conductivities in packed, fluidized, and moving-bed reactors were measured for graft polymerization of the poly(vinyl chloride) powder. The effective heat conductivity for the moving-bed was 2.2×10^{-2} kcal/m.hr.°C, nearly the same as for the packed bed. The overall heat transfer coefficients were also measured for the two stirred moving-bed reactors, CG-1 and CG-2, for the pilot plant of graft copolymerization of butadiene onto the poly(vinyl chloride) powder with ^{60}Co γ rays. The CG-1 with an "anchor type" stirring blade has a very low conductivity of 5×10^{-2} kcal/m.hr.°C, even with agitation; no significant difference from that in the packed bed reactor. The overall heat transfer coefficient of CG-2 with a "plow type" stirring blade is very high, more than 20 kcal/m^2.hr.°C. (auth)

19606 (ORO-4062-12) ELDOR INVESTIGATIONS OF RADIATION PROCESSES. ANNUAL PROGRESS REPORT, 1972–1973. Kispert, L. D. (Alabama Univ., University. Dept. of Chemistry). 1973. Contract AT(40-1)-4062. 22p. Dep. NTIS.

19607 (RRL-3238-425) QUARTERLY REPORT, OCTOBER 1–DECEMBER 31, 1972. (Mellon Inst. of Science, Pittsburgh, Pa. Radiation Research Labs.). 25 Jan 1973. Contract AT-(11-1)-3238. 19p. Dep. NTIS.

Abstracts of reports issued from October 1, 1972 to December 13, 1972 are presented and publications resulting from research at the Institute are listed. (DHM)

19608 UNSTABLE INTERMEDIATES. Pt. 123. Electron Spin Resonance Spectra of Radicals in γ-Irradiated Sulphuryl Chloride: the $SO_2Cl_2^-$-Radical. Rao, K. V. S.; Symons, M. C. R. (Univ. of Leicester, Eng.). J. Chem. Soc., Dalton Trans.; No. 1, 9-12(1973).

The major species detected by ESR spectroscopy in γ-irradiated sulphuryl chloride at 77°K is thought to be $SO_2Cl_2^-$. The ^{33}S and ^{35}Cl hyperfine components and the g-tensor components are in accord with this suggestion, and show that the radical anion is comparable with others in this class, having the unpaired electron primarily on sulphur (~76%) with a very high 3s-character (~29%), and on the two equivalent chlorine atoms with a high 3p-character (~23%) The form of the molecular orbital involved is discussed. (auth)

19609 ELECTRON SPIN RESONANCE STUDIES OF γ-IRRADIATED POTASSIUM HEXACYANOFERRATE(II) IN VARIOUS HOST LATTICES. Symons, M. C. R.; Wilkinson, J. G. (Univ. of Leicester, Eng.). J. Chem. Soc., Dalton Trans.; No. 1, 14-18 (1973).

Four major Fe(I) species were detected, one exhibiting hyperfine coupling to one ^{14}N nucleus (N_1), one with coupling to two equivalent ^{14}N nuclei (N_2), one with coupling to one ^{14}N nucleus and one halide nucleus (N_1Hal_1) and one with coupling to two equivalent halide nuclei (Hal_2). The N_1 species is thought to be $Fe(CN)_4CN'H_2O^{4-}$, formed from $Fe(CN)_4H_2O^{3-}$ impurity ions, in which the CN' ligand is slightly bent off the Fe–CN axis. The N_2 species has two trans-cyanide ligands comparably bent off the axis. The halide complexes are then $Fe(CN)_4CN'Hal^{5-}$ and $Fe(CN)_4(Hal)_2^{5-}$ ions respectively, with the halide ligands or halide and bent cyanide ligands in a transconfiguration. In one case, a species exhibited hyperfine coupling to one ^{14}N nucleus and one proton. This is thought to be an Fe(I) complex containing the Fe-CNH unit. (auth)

19610 COMPARATIVE CHARACTERISTIC OF SOME SOLID TARGETS USED FOR REACTIONS OF HOT TRITIUM ATOMS. Barnov, V. A.; Beniashvili, L. N.; Krupennikova, A. Yu. pp 34-39 of Yaderno-Khimicheskie Yavleniya v Tverdykh Telakh. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian).

Comparison of yields of ethane labeled with tritium was made for the following targets: (1) ethane in the presence of a tritium solid source–lithium carbonate; (2) ethane adsorbed on the NaA zeolite in the presence of lithium carbonate; and (3) ethane adsorbed on the zeolite of the A type in the crystal lattice in which lithium was introduced by cation exchange. It is shown that lithium-replaced zeolite, with hydrocarbon adsorbed on it, is an optimal target for nuclear reactions with tritium for the production of labeled compounds. (auth)

19611 RADIATION TRANSFORMATION OF THE MIXTURE $C_2H_6 + T_2$ ON THE SURFACE OF SILICON OXIDE. Tsetskhladze, T. V.; Cherkezishvili, L. I. pp 75-80 of Yaderno Khimicheskie Yavleniya v Tverdykh Telakh. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian).

The action of reactor radiation on interaction of ethane with tritium was studied in the homogeneous phase and in the presence of silicon oxide. The depth of ethane radiation transformation was considerably increased in the presence of a solid. The mechanism of production of labeled products should be connected with the formation of radicals since in the presence of the acceptor (iodine), under the conditions of irradiation, the reaction of interaction of $C_2H_6 + T_2$ practically stops completely. (auth)

19612 INTERACTION OF RECOIL ATOMS OF TRITIUM WITH ADSORBED ETHANE IN THE PRESENCE OF INERT MODERATORS. Tsetskhladze, T. V.; Cherkezishvili, L. I. pp 81-89 of Yaderno-Khimicheskie Yavleniya v Tverdykh Telakh. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian).

The influence of inert moderators He, Ar, Kr on the character of interaction of energetic tritium atoms with ethane targets was studied. The nuclear reaction $^6Li(n,\alpha)T$ was used as tritium source. Iodine was the acceptor. In the absence of iodine, when inert moderators were added, the ratio of the main products of hot interaction HT/C_2H_5T decreases with increase of moderator pressure, while in gaseous moderated systems without the acceptor this ratio increases. A decrease of HT/C_2H_5T with an increase of moderator amount may be explained by two reasons: either the penetration of tritium atom into an ethane molecule takes place at lower energies than the formation of HT by means of the hot reaction, or the thermal process of radiation exchange on silicon oxide surface takes place in the formation of labeled molecule of the target. Iodine was used for inhibition of thermal processes of exchange. In the presence of the acceptor the mentioned ratio begins to grow with an increase of the moderator amount. Its numerical value depends on the iodine amount. In the specimens with a higher iodine concentration, the value of the ratio was much smaller than in a nonacceptor system. In the specimens with a small acceptor concentration this ratio is much larger. It was concluded that the hot abstraction reaction of hydrogen takes place in a lower energy region for tritium atom than the reaction of hot replacement with the formation of C_2H_5T. (auth)

19613 REDUCTION OF COBALAMIN. A Pulse Radiolysis Study. Faraggi, M.; Leopold, J. G. (Atomic Energy Commission, Beer-Sheva, Israel). Biochem. Biophys. Res. Commun.; 50: No. 2, 413-420(23 Jan 1973).

The reaction of B_{12} with e^-_{aq} and CO_2^- was investigated by the pulse radiolysis technique. The decay of the e^-_{aq}, B_{12} and the formation of B_{12r} were found to be concomitant bimolecular processes with specific rates ranging from $5 \times 10^{10} M^{-1}$ sec^{-1} at pH 6.1, to $3 \times 10^{10} M^{-1}$ sec^{-1} at pH = 11.1. The reduction of B_{12} by CO_2^- was also a bimolecular process with a specific rate of $1.2 \times 10^9 M^{-1}$ sec^{-1}. CO_2^- was found to be more specific toward the metal ion (90% yield). No reaction whatsoever was detected when trying to reduce B_{12} with O_2^-. B_{12r} reacted with molecular oxygen. (auth)

19614 ION-EXCHANGE FOAM CHROMATOGRAPHY. Part I. Preparation of rigid and flexible ion-exchange foams. Braun, T.; Bekeffy, O.; Haklits, I.; Kadar, K.; Majoros, G. (Lorand Eoetvoes Univ., Budapest). Anal. Chim. Acta; 64: No. 1, 45-54(Mar 1973).

In order to be able to apply the principles of foam chromatography to ion exchange processes, preparative methods for open-cell ion exchange foams were investigated. Homogeneous ion exchange foams were prepared by introducing ion exchange groups on previously prepared phenol–formaldehyde, polyurethane, and polyethylene foams. The maximum capacity of the produced sulfonated phenol–formaldehyde cation exchange foams was 1.85 meq g^{-1}; that of the styrene–polyurethane interpolymer anion exchange foams was 2.2 meq g^{-1}. Weak carboxylic ion exchange foams were prepared by radiation grafting of polyurethane and

polyethylene foams; the maximum capacity of these foams was 4.02 meq g^{-1}. Heterogeneous ion exchange foams were prepared by foaming a fine powder of a commercially available cation exchanger with the precursors of open-cell polyether-type polyurethane foam. The capacity of such a foam containing 26% ion exchange powder was 1.0 meq g^{-1}. The kinetics of the cation exchange process on the heterogeneous foams was measured with ^{85}Sr. (auth)

19615 HYDRATED PROTON $H^+(H_2O)_n$. I. A Single Crystal Neutron Diffraction Study of the Oxonium Ion in p-Toluenesulfonic Acid Monohydrate, $H_3O^+CH_3C_6H_4SO_3^-$. Lundgren, J. O.; Williams, J. M. (Argonne National Lab., IL). J. Chem. Phys.; 58: No. 2, 788-796(15 Jan 1973).

The pyramidal nonplanar conformation of the oxonium ion was confirmed in the first single crystal neutron diffraction study of a salt containing discrete H_3O^+ cations in an isolated state, p-toluenesulfonic acid monohydrate ($H_3O^+CH_3C_6H_4SO_3^-$). All H atoms were located to high precision and the cation has molecular dimensions O–H=1.011(8) (the numbers within parentheses are the estimated standard deviations in the least significant digits). 1.013(8), and 1.008(8) Å with H–O–H angles of 110.7(5), 109.2(5), and 111.2(5)°. The oxygen atom is 0.322(4) Å out of the plane of the three hydrogen atoms. Although unrestricted by crystal symmetry, the ion has essentially C_{3v} symmetry. O–H separations are characteristic of those found in similarly strongly H-bonded systems where the O ... O separations are fairly short at 2.53 Å. The structure was determined using 1732 independent three-dimensional intensities measured using a neutron wavelength of 1.142 Å. The crystals are monoclinic, space group $P2_1/c$, with unit-cell dimensions (x ray) a = 5.881, b = 7.432, c = 20.085 Å, and $\beta = 97.95°$. The structure was refined by full-matrix least-squares procedures, using anisotropic thermal parameters for all atoms, to an $R(F^2)$ of 0.067. (auth)

19616 KINETIC STUDIES ON THE GRAFT COPOLYMERIZATION OF METHYL METHACRYLATE ONTO PREIRRADIATED STARCH GRANULES BY ELECTRON ACCELERATOR. Handa, Takashi (Science Univ. of Tokyo); Otsuka, Nobuyoshi; Takahashi, Atsushi; Ayukawa, Yaichi. Kobunshi Kagaku; 29: No. 329, 625-630(Sep 1972). (In Japanese).

The following nonsteady-state equation was derived for the estimation on the polymerization rate (Rp) with respect to the heterogeneous graft copolymerization of methyl methacrylate on preirradiated starch granules: $R_P = [k_p(R\cdot)_0/k_t]\ [A - k'(R\cdot)_0 e^{-At} - k_t''(R\cdot)_0 b_0 t](-b_0 t)$; $A = k_t' R\cdot(R\cdot)_0 + k_t M^*(M^*)_0 + k_t'(R\cdot)_0 RM\cdot$; $-b_0 = k_t M^*(M^*)_0 e^{-At} - k_t(R\cdot)_0 RM\cdot^2 - k_t''(R\cdot)_0 RM\cdot e^{-At}$; $R\cdot = (R\cdot)/(R\cdot)_0$ $RM\cdot = (RM\cdot)/(R\cdot)_0$ $M^* = (M^*)(M^*)_0$, where (R·) is the concentration of starch radicals, (RM·) concentration of propagating radicals, (M*) monomer concentration inside granules in mole/l respectively, suffix 0 represented the initial state and $k_p k_t k_t' k_t''$ were the usual rate constants for the elementary reactions. For estimation on the respective parameters in the above equation with respect to the check on the termination, the reaction was divided into three steps for the change of (RM·) and M* by the attenuating ESR signals and by gas-chromatographic analysis, respectively. The correlation between k_t and k_t'' was also obtained. The reaction mode of the acceleration by gel-effect in the presence of water and of the termination in the heterogeneous phases were characterized by the above experimental parameters involved with the monomer transport. (auth)

19617 RELATION BETWEEN THE MODE OF TERMINATION REACTION IN GRAFT COPOLYMERIZATION ONTO PREIRRADIATED STARCH AND THE MOLECULAR WEIGHT DISTRIBUTION OF GRAFTED POLY(METHYLACRYLATE) CHAINS. Handa, Takashi (Science Univ. of Tokyo); Otsuka, Nobuyoshi; Takahashi, Atsushi; Ayukawa, Yaichi. Kobunshi Kagaku; 29: No. 329, 630-634 (Sep 1972). (In Japanese).

The mode of the termination reaction was studied on the basis of the theoretical equations derived in previous studies and the molecular-weight distribution of grafted poly(methyl methacrylate) chains. The order of rate constant of the termination, k_t, was pursued on the basis of the reaction characteristics and by introducing a new parameter, f', which represents the ratio of disproportionation in the bimolecular termination reaction. A correlation diagram between f' and k_t was obtained covering the range of respective disproportionation of the grafted chain. The order of k_t of the reaction was estimated by the use of the convergent value of f' in these diagrams. (auth)

19618 UNSTABLE INTERMEDIATES. Pt. 119. Electron Spin Resonance Studies of Radiation Effects Upon Cyanate and Thiocyanate Ions in Alkali Metal Halide Crystals and in Aqueous Glasses. Ginns, I. S.; Symons, M.C.R. (Univ. of Leicester, Eng.) J. Chem. Soc., Dalton Trans.; No. 1, 3-9(1973).

Irradiated crystalline sodium or potassium cyanate at 77°K had ESR spectra dominated by a quintet assigned to the radical N_2CO^-, and a triplet assigned to NCO^{2-}. The latter had a ^{13}C hyperfine tensor characteristic of a bent radical as expected, since it is isoelectronic with NO_2. In contrast, aqueous glasses containing these salts gave, on irradiation, spectra which have been interpreted in terms of trapped nitrogen atoms and $HCNO^-$ radicals. The latter radicals are characterised by an unusually large proton hyperfine coupling, which is interpreted in terms of protonation on carbon. Potassium thiocyanate had an ESR spectrum, after irradiation, which has been interpreted in terms of the dimer anion $(NCS)_2^-$, well known in pulse-radiolysis studies, and the anion NCS^{2-}. On being annealed, sharp features, thought to be characteristic of NO_3 molecules, developed. The radical CNS^{2-}, like CNO^{2-}, is shown to be strongly bent by analysis of its ^{13}C tensor components. Aqueous glasses gave mainly $HCNS^-$ at 77°K, which is magnetically very similar to $HCNO^-$. Nitrogen atoms were not detected. The radicals CNO and CNS were not positively identified in these studies, although their formation could not be ruled out. (auth)

19619 REACTION OF HYDRATED ELECTRONS WITH METHANOL MOLECULE. Kalyazin, E. P.; Byakov, V. M.; Pestov, A. V. Vestn. Mosk. Univ., Ser. II. Khim.; 13: No. 5, 600-602(1972). (In Russian).

Hydrated electrons are supposed to react with methanol and to yield not only-H atoms but CH_3 radicals. Methane and ethanol are shown to form in methyl radical reactions. (auth)

19620 COMMENT ON THE NATURE OF THE FREE RADICALS PRODUCED DURING HIGH-ENERGY IRRADIATION OF ADAMANTANE. Marx, R. (Paris Univ., Orsay, France). Chem. Phys. Lett.; 17: No. 1, 152(1 Nov 1972).

The assignment by Filby and Guenther (Chem. Phys. Lett., 17: No. 1, 150-1) of 1-adamantyl radical to spectra obtained by γ irradiation of purified adamantane at room temperature is questioned. (DHM)

19621 NATURE OF THE FREE RADICALS PRODUCED DURING HIGH-ENERGY IRRADIATION OF ADAMANTANE. Filby, W. G.; Guenther, K. (Kernforschungszentrum, Karlsruhe, Ger.). Chem. Phys. Lett.; 17: No. 1, 150-151(1 Nov 1972).

Contrary to a recent report no evidence was found for the presence of thermally rearranged radicals in γ irradiated adamantane. (auth)

19622 HYDROGEN ABSTRACTION BY THIYL RADICALS. Pryor, W. A.; Gojon, G.; Stanley, J. P. (Louisiana State Univ., Baton Rouge). J. Amer. Chem. Soc.; 95: No. 3, 945-946(7 Feb 1973).

A quantitative study of hydrogen abstraction by thiyl radicals (a ubiquitous species in radiation biology) for organic substances [RS· + QH $\xrightarrow{k_H}$ RSH + Q· (1)] is presented. The method was conceived in order to take advantage of the reversibility of eq 1 which has hindered previous studies. The key of the method is to utilize tritium-labeled thiol as solvent; in this milieu, Q· radicals generated in eq 1 abstract hydrogen from RSH* to reform the substrate QH* which is now tritium-labeled. The level of radioactivity in the recovered QH* can be related to the specific rate constant for eq 1. Two kinetic schemes were developed for determining relative values of k_H. (DHM)

19623 REDUCTION WITH TRICHLOROSILANE. II. Mechanistic Study of Reduction of Methyl Acetate to Ethyl Methyl Ether. Nagata, Y.; Dohmaru, T.; Tsurugi, J. (Radiation Center of Osaka Prefecture, Sakai, Japan). J. Org. Chem.; 38: No. 4, 795-799 (23 Feb 1973).

The kinetics of the previously reported reduction of alkyl aliphatic carboxylates with trichlorosilane under γ and photoirradiations was studied by using methyl acetate as a starting material. Initially the stoichiometry corresponded to $CH_3COOCH_3 + 3Cl_3SiH \rightarrow C_2H_5OCH_3 + SiCl_4 + HSiCl_2OSiCl_3$. However, since trichlorosiloxydichlorosilane behaved similarly to trichlorosilane, the amount of trichlorosilane consumed at the later stage of the reaction was smaller than 3 mol and the amount of trichlorosiloxydichlorosilane produced was less than 1 mol. Acetaldehyde was detected together with ethyl methyl ether by glpc analysis. The formations of intermediates, acetal type and α-chloroethyl methyl ether, were supported by several results. These intermediates gave acetaldehyde during glpc analysis, and were converted to ethyl methyl ether under irradiations with trichlorosilane. A free-radical chain mechanism via these intermediates was proposed. The rate of methyl acetate consumption is derived as $-d[\text{methyl acetate}]/dt = k(\text{dose rate})^{1/2} \times [\text{trichlorosilane}]$ by assuming that recombination of $CH_3\dot{C}(OSiCl_3)OCH_3$ radicals predominates over other termination steps. This rate equation is consistent with the results obtained by kinetic determinations. A small amount of benzene added to the

reaction system was found to strongly retard the reaction, suggesting that benzene acts as a scavenger of trichlorosilyl radical. (auth)

19624 METHOD FOR RADIATION GAS PHASE REACTIONS. Kasamatsu, T.; Sakurai, H. (to Japan Atomic Energy Research Inst.). U. S. Patent 3,711,387. 16 Jan 1973. Priority date 6 May 1968, Japan. 6p.

A method is presented for promoting gas phase reactions. The Geiger–Muller region of the reaction zone is treated with ionizing radiation, and sufficient potential gradient is induced to produce a continuous discharge when an ion pair is generated. When the gaseous reactant is oxygen, ozone is produced; hydrogen peroxide is produced from oxygen and hydrogen, and hydrazine from ammonia. The radiation may be either α, β, γ, or x. (JGB)

19625 MODE OF REACTION OF HYDROGEN ATOMS WITH ORGANIC COMPOUNDS IN AQUEOUS SOLUTIONS. Witter, R. A.; Neta, P. (Carnegie–Mellon Univ., Pittsburgh). J. Org. Chem.; 38: No. 3, 484–487 (9 Feb 1973).

Yields of hydrogen from γ-irradiated aqueous solutions of organic compounds were determined. From these yields the portion of H atoms reacting by H abstraction was calculated. Using previous rate data the partial rate constants for the abstraction and for the other reactions which do not yield hydrogen were derived. Correlation of structure and partial reactivities has led to some generalized patterns of reaction. Benzylic and allylic hydrogens were found to be respectively ~3 and ~5 times more reactive in abstraction reaction than those adjacent to methyl groups. An enol site adds hydrogen atoms with a partial rate constant of 1×10^8 M^{-1} sec^{-1} and a carbonyl group only ~10^6 M^{-1} sec^{-1} so that the reactivity of carbonyl compounds is largely dependent on their enol content. Partial rate constants have also been assigned to several other functional groups. (auth)

19626 ELECTRON SPIN RESONANCE SPECTRA OF THE RADICALS PRODUCED IN THE RADIOLYSIS OF AQUEOUS SOLUTIONS OF FURAN AND ITS DERIVATIVES. Schuler, R. H.; Laroff, G. P.; Fessenden, R. W. (Carnegie–Mellon Univ., Pittsburgh). J. Phys. Chem.; 77: No. 4, 456–466 (15 Feb 1973).

The esr spectra of radicals produced by addition of H atoms and OH radicals to the position adjacent to the heterocyclic oxygen atom of furan and a number of its derivatives have been observed during the continuous radiolysis of their acidic solutions. The radicals are allylic in character and exhibit hyperfine constants for the protons at the 2, 3, and 4 positions which are typical of an allylic system. The H atom adducts are characterized by hyperfine constants of the protons at the 5 position of 30–35 G. Such values are considerably larger than that of 23.0 G for the β protons in the structurally related hydrocarbon radical cyclopentenyl. This observed difference is attributable to the presence of a small but significant spin density on the ring oxygen atom which causes a large increase in the value of the electronic wave function at the positions of these protons. The radicals produced by addition of OH have hyperfine constants for the protons at the allylic positions which are similar to those of the H atom adducts. The CH proton of the –CHOH– group in these radicals, however, has an hyperfine constant of only 19–21 G and reflects an effect of OH substitution similar to that found in the comparison of cyclohexadienyl and hydroxycyclohexadienyl radicals. In basic solutions of furan, ring opening follows OH addition and the radical anion of butenedial is formed. Related highly conjugated radicals are produced from furfuryl alcohol, furfural, furylacetonitrile, 2-furoic acid, 3,4-furandicarboxylic acid, 2,5-furandicarboxylic acid, 2-acetylfuran, 2-furonitrile, and furylacrylic acid. Because of conjugation, these radicals can exist in a number of isomeric forms. Several isomeric radicals were observed to be produced simultaneously in the case of carboxylic acids. In very basic solutions of 2,5-dimethylfuran abstraction of one of the methyl hydrogen atoms occurs and results in the formation of a very interesting cyclic conjugated radical. The spin distribution in this radical shows that the oxygen atom induces a significant negative contribution on the atoms to which it is attached. (auth)

19627 G FACTOR AND HYPERFINE COUPLING ANISOTROPY IN THE ELECTRON SPIN RESONANCE SPECTRA OF METHYL-, ETHYL-, AND ALLYL-TYPE RADICALS ADSORBED ON SILICA GEL. Shiga, T.; Lund, A. (Swedish Research Councils' Lab., Studsvik). J. Phys. Chem.; 77: No. 4, 453–455 (15 Feb 1973).

Analysis of the asymmetric ESR spectra of radicals sorbed on silica gel give the following axially symmetric parameters at 77°K; for the methyl radical $A_\perp = -22.6$ G, $A_\parallel = -21.9$ G, $g_\perp = 2.0027$, and $g_\parallel = 2.0024$; for the ethyl radical $A_\perp = -20.0$ G and $A_\parallel = -29.9$ G; for the α protons and $A_\perp = 26.0$ G and $A_\parallel = 27.9$ G; for the methyl protons $g_\perp = 2.0029$ and $g_\parallel = 2.0032$. The radicals were produced at 77°K by γ radiolysis of methyl, ethyl, and allyl iodides absorbed on silica gel. These data suggest that at 77°K the methyl radicals rotate about an axis perpendicular to the planes of the radical, whereas the ethyl radical rotates about the C–C bond axis. The analysis of spectra from allyl and methallyl radicals is less conclusive. (auth)

19628 ADDITION OF HYDROXYL RADICALS TO PYRIMIDINE BASES AND ELECTRON TRANSFER REACTIONS OF INTERMEDIATES TO QUINONES. Hayon, E.; Simic, M. (Army Natick Labs., MA). J. Amer. Chem. Soc.; 95: No. 4, 1029–1035 (21 Feb 1973).

The transient optical absorption spectra of the radicals produced from the reaction of hydroxyl radicals with pyrimidine bases in aqueous solution were determined using the technique of pulse radiolysis. Uracil, thymine, cytosine, 1- and 3-methyluracil, 1,3-dimethyluracil, and dihydrouracil were studied as a function of pH in order to examine the role of the tautomeric forms of the pyrimidine bases with regard to the site(s) of OH radical addition. The transient spectra obtained at pH ~11.0 in solutions of uracil, thymine, and 1- and 3-methyluracil were different from those observed in neutral solution. Examination of the change in initial absorbance at a fixed wavelength with pH revealed a "titration-type" curve from which a pK was derived. In all cases, the pK value obtained was identical with the pK^1_1 of the pyrimidine base used, indicating that the changes in the spectra are due to the tautomerization of the molecule and not to the acid–base properties of the OH-radical adducts to the pyrimidines. The transient spectrum of the radical produced from OH addition to 1,3-dimethyluracil was identical in neutral and alkaline solutions, supporting the above conclusion. With cytosine, the pK ~ 4.5 ± 0.1 obtained corresponded to the pK^1_3 ~ 4.6 for the proton dissociation of N_3. The observed red shift of the transient spectra in alkaline solution, compared to neutral solution, is probably due to the increased resonance energies of the lactim form vis-a-vis the lactam form of the pyrimidines radicals. From the deday kinetics of the intermediates, it is suggested that substitution at the N_1 position reduces the extent of ring opening which results from radical addition across the 5,6 double bond. The intermediates produced were found to react with menaquinone (vitamin K_3, $E^\circ = 0.42$ V) leading to the formation of the semiquinone radical anion MQ^-. The reaction rate constants for electron transfer to MQ were found to be relatively high, ~$1-5 \times 10^9$ M^{-1} sec^{-1}, for the large number of bases examined. The efficiency of electron transfer (i.e., percentage) was found to be markedly dependent upon the nature of the pyrimidine and nucleotide examined, as well as on the tautomeric form. Increased efficiency of electron transfer occurs when the odd electron is resonating with ionic tautomeric forms of the pyrimidine radicals. Various explanations are offered for these results. The dissociation constant of the semiquinone radical of menaquinone was found to be 4.5 ± 0.1. (auth)

19629 RADIATION POLYMERIZATION OF VINYL CARBORANES AND NOVEL PRODUCTS RESULTING THEREFORM. Klingen, T. J.; Wright, J. R. (to United States Atomic Energy Commission). U. S. Patent 3,699,024. 17 Oct 1972. Filed 29 Oct 1970.

A method is described for the radioinduced polymerization of vinylcarboranes to produce a unique series of polymeric products ranging from the dimer, trimer, tetramer, and pentamer to a polymeric product having a molecular weight corresponding to as much as 20 monomer unit chains of the monomer. The monomer is selected from those described by the generic formula $\Theta-C(R_1)=CR_2H$ where Θ is the carborane cage structure and the vinyl group is attached to one of the carbons in the borane cage, R_1 is H or CH_3, and R_2 is H or an alkyl group. (DHM)

19630 INVESTIGATION OF γ-RAY INDUCED POLYMER FORMATION IN THE CARBORANES. 2. Dynamics of the Polymerization of 1-Vinyl-o-Carborane in the Liquid and Plastic Crystalline States. Wright, J. R.; Klingen, T. J. (Univ. of Mississippi, University). J. Inorg. Nucl. Chem.; 35: No. 1, 53–59 (Jan 1973).

G(-m) values were measured for polymerizing bulk 1-vinyl-o-carborane as functions of dose, temperature, dose rate, and scavengers, using as a source ^{60}Co γ-rays. Also, an attempt was made to compare the radiolysis polymer with thermochemically polymerized 1-vinyl-o-carborane. The monomer is plastic crystalline between 11 and 79°C, and it was found that this phase was characterized by liquid-like polymerization dynamics, i.e. a plot of $\log_{10}$ G(-m) versus T^{-1} was linear over a 175°C range and continuous within the experimental error at the capillary melting point (79°C). Overall E_a was 3.3 kcal/mole, which should be regarded as a lower limit for the propagating step. The contribution of second order termination of the active intermediate may be evaluated through the dose rate of polymerization. This relationship is of the approximate form $R_p = CI^n$, where C is a constant and I is the dose rate. The experimental value of n was 0.76. (auth)

19631 MOESSBAUER STUDIES OF ELECTRON-IRRADIATED FERRICYANIDES. Baggio-Saitovitch, E.; Raj, D.; Danon, J. (Centro Brasiliero de Pesquisas Fisicas, Rio de Janeiro). Chem. Phys. Lett.; 17: No. 1, 74-77(1 Nov 1972).

Hydrated ferricyanides are reduced by electron irradiation to the corresponding ferrocyanides, but no effect is observed with anhydrous complexes. Reduction is attributed to hydrogen radicals which originated from the radiolysis of water. Different results are obtained with silver ferricyanide, which are explained by the formation of an isocyanide bond in the irradiated complex. (auth)

19632 KINETICS OF THE THERMAL REACTIONS OF SILVER ATOMS ADSORBED ON SILICA GEL AND ALUMINOSILICATES. Popovich, G. M.; Golubev, V. B.; Bugaenko, L. T. (Moscow State Univ.). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 5, 738-740 (May 1972).

Translated from Zh. Fiz. Khim.; 46: No. 5, 1284-1288(May 1972).

The kinetics of the reactions of silver atoms trapped on the surface of silica gels and alumino-silicates were investigated in the range between −196 and −50°C. The silver atoms were generated by the action of ^{60}Co γ-rays at −196°C on Ag^+ ions adsorbed on the surface of silica gel and aluminosilicates from aqueous silver nitrate solutions. The kinetic curves for the destruction of silver atoms trapped on silica gel and aluminosilicate consist of a series of steps. A kinetic scheme, which accounts for the observed steps, is proposed to describe the processes occurring when the temperature of the irradiated matrices rises. The kinetic parameters were determined from the experimental curves. (auth)

19633 EFFECT OF IONIZING RADIATION ON THE ELUTING CAPACITY OF LACTIC ACID. Maslova, G. B.; Nazarov, P. P.; Sukhinina, N. A.; Chmutov, K. V. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 5, 706-708(May 1972).

Translated from Zh. Fiz. Khim.; 46: No. 5, 1226-1229(May 1972).

The effect of γ-radiation on the eluting capacity of lactic acid was investigated. With increase of radiation intensity, the pH of the lactic acid solution and the partition coefficient of radiocerium between KU-2 resin and the irradiated solution both change. The decrease of the partition coefficient may be accounted for by the formation of more stable lanthanide complexes. (auth)

19634 THERMAL AND RADIATION STABILITY OF MACROPOROUS SULFONIC ACID CATION-EXCHANGE RESINS BASED ON STYRENE-DIVINYLBENZENE COPOLYMERS. Tulupov, P. E.; Lyustgarten, E. I.; Stebeneva, I. G. (Physical Chemical Inst., Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 5, 689-693(May 1972).

Translated from Zh. Fiz. Khim.; 46: No. 5, 1196-1201(May 1972).

In sulfonic acid cation exchange resins based on styrene-divinylbenzene copolymers, there are three types of energetically nonequivalent sulfo-groups, differing in the kinetic parameters for thermal hydrolysis. After irradiation in water, all the sulfo-groups are equivalent. (auth)

19635 EFFECT OF ^{60}Co γ RADIATION ON DIPHENYLTELLURIUM, PURE AND IN SOLUTION. Thomas, A.; Llabador, Y. (CNRS, Strasbourg). Radiochim. Acta; 17: No. 4, 202-205 (Nov 1972). (In French).

The products formed during the γ radiolysis of diphenyltellurium, pure and dissolved in benzene, were analyzed by gas chromatography. In the pure compound, the main products are: benzene, diphenyl, and diphenylditellure. The yield of the latter decreases markedly in the presence of oxygen. In no case is elementary tellurium found. The proposed primary process involves the rupture of a carbon-tellurium bond. (auth)

19636 EFFECT OF ACCELERATING VOLTAGE AND SPECIMEN TEMPERATURE ON RADIATION DAMAGE OF HEXADECACHLOROPHTHALOCYANINE COPPER. Harada, Y. (Electron Optics Div., Tokyo); Taoka, T.; Watanabe, M.; (and others) pp 686-687 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

19637 THIN SUBSTRATE STRUCTURE AND ELECTRON SCATTERING AFTER EM BEAM EXPOSURE. Hill, B. C.; Haydon, G. B. (Stanford Univ., CA). pp 688-689 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

19638 INTERACTION OF FAST ELECTRONS WITH AROMATIC AMINO ACIDS. Lin, P. S. D. (Univ. of Chicago). pp 690-691 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

19639 FREE RADICALS IN MALONIC ACID: A STUDY OF RADICAL CONFORMATIONS AT 77 K AND 295 K BY THE ESR-TECHNIQUE. Bergene, R.; Meloe, T. B. (Univ. of Oslo). Biophysik; 9: No. 1, 1-12(1972).

Single crystals of malonic acid ($CH_2(COOH)_2$) were irradiated with 4.0 MeV electrons at liquid nitrogen temperature. The induced radicals were identified by electron spin resonance technique. ESR lines due to different conformations of the $\dot{C}H_2(COOH)$ radical are observed. ESR lines due to the $\dot{C}OOH$ radical are also seen. It is suggested that the fragmentation into these radicals takes place preferentially on one side of the molecule and subsequent to the ionization event. Upon warming of the crystal to room temperature, the $\dot{C}OOH$ radical disappears and the $\dot{C}H(COOH)_2$ radical is formed. The latter radical seems to exist in two slightly different modifications. (auth)

19640 RADIOGRAPHICAL STUDY OF Cu-Ni CATALYSTS IRRADIATED WITH α-RAYS. Takeuchi, Toyosaburo; Tezuka, Yoshisato; Miyatani, Daisaku; Nakashima, Yoshifumi; Aizumi, Yutaka (Toyama Univ., Japan). Z. Phys. Chem. (Frankfurt); 81: No. 1-4, 98-112(Oct 1972).

The effects of α irradiation on the adsorption of hydrogen and the reactivity of the adsorbed hydrogen in the hydrogenation reaction of ethylene on two types of copper-nickel alloys, sheets and evaporated films, were investigated by means of autoradiography using tritium as a tracer. In the case of alloy sheets, a marked increase on irradiation in the amount of adsorbed hydrogen was found at the region carrying the alloy. In the case of the evaporated films, the amount of adsorbed hydrogen in the alloy region decreased upon irradiation, when the film was preliminarily sintered at 30°C. However, the amount increased, when the film was preliminarily sintered at 250°C. The change in the activity upon irradiation was formulated as the function of the electronic factor and the structural factor of the alloy. (auth)

19641 QUANTATIVE STUDIES ON RADIATION-INDUCED DISLOCATIONS AND THE DECOMPOSITION KINETICS OF AMMONIUM PERCHLORATE. Herley, P. J. (Picatinny Arsenal, Dover, NJ); Levy, P. W. pp 387-395 of Reactivity of Solids. Anderson, J. S. (ed.). London; Chapman and Hall Ltd. (1972).

From 7th International Symposium on the Reactivity of Solids; Bristol, United Kingdom of Great Britain and Northern Ireland (UK) (17 Jul 1972). See CONF-720703-.

Ammonium perchlorate crystals exposed to gamma rays or x rays exhibit etch pit movement and greatly increased etch pit concentrations. Few dislocations are induced below 10^5 rad, between 10^5 and 10^6 rad the concentration increases linearly, and above 10^6 rad the concentration is too large to determine accurately. These results suggest an explanation for the increased thermal decomposition rate and shortened induction period exhibited by crystals exposed to radiation prior to decomposition. Since dislocations become decomposition nuclei, the accelerated decomposition rates result from the additional dislocations, i.e. nuclei, introduced during irradiation. Apparently trapped gaseous decomposition products, e.g. in voids, exert sufficient stress to generate dislocations by well-known mechanisms. (auth)

19642 ENDOR STUDY OF THE RADICAL CREATED BY GAMMA IRRADIATION AT ROOM TEMPERATURE IN THE 1,2,4-TRIAZOLE CRYSTAL. Proton Hyperfine Tensors and Spin Density Distribution. Gloux, P.; Lamotte, B. (CEN, Grenoble, France). Mol. Phys.; 25: No. 1, 161-180(Jan 1973).

From the complete ENDOR study of the radical induced by gamma irradiation at room temperature of single crystals of 1,2,4-triazole it is possible, by analysis of all the measured proton hyperfine tensors, to determine its exact nature. It corresponds to a π radical formed by the addition of one hydrogen atom to a carbon of the ring. An unconventional but satisfying determination of the map of the spin density distribution in the radical was carried out using basically the theoretical reconstitutions of the dipolar tensors. These results are discussed and compared with those of molecular orbital calculations. (auth)

19643 KINETICS OF OZONE FORMATION IN THE PULSE RADIOLYSIS OF OXYGEN GAS. Bevan, P.L.T.; Johnson, G.R.A. (Univ. of Newcastle upon Tyne, Eng.). J. Chem. Soc., Faraday Trans., I; 69: No. 1, 216-227(1973).

The kinetics of O_3 formation after an electron pulse were studied in O_2, at pressures from 7 to 400 kN m^{-2}, by optical absorption measurements in the range 250 to 330 nm. The absorption spectra at different times and the time-dependence of the absorption at 250, 270, and 310 nm are interpreted in terms of three, kinetically distinguishable, consecutive reactions: $O + O_2 + O_2 \xrightarrow{k_1} O_3^\alpha + O_2$; $O_3^\alpha + O_2 \xrightarrow{k_2} O_3^\beta + O_2$; and $O_3^\beta + O_2 \xrightarrow{k_3} O_3 + O_2$. The intermediates, O_3^α and O_3^β, which are assumed to be vibrationally excited O_3, have broad absorptions and maxima at approximately 310 and 285 nm, respectively. The kinetic analysis leads to a value of $k_1 = 5.4 \pm 0.3 \times 10^{-34}$ cm^6 $molecule^{-2}$ s^{-1} and also gives values for the rate constants of the reactions that deactivate excited O_3. In mixtures of O_2 with various other gases, values were obtained for the rate constants of the reactions $O + O_2 + M \xrightarrow{k_{1a}} O_3^\alpha + M$; $K_{1a} = 2.7 \pm 0.3$, 13.0 ± 1.5, 13.3 ± 1.2, $31 \pm 3 \times 10^{-34}$ cm^6 $molecule^{-2}$ s^{-1} for M = Ar, N_2O, CO_2, and SF_6, respectively. CO_2 and SF_6 are efficient deactivators of excited O_3; values are reported for the rate constants for deactivation of O_3^β by these molecules. (auth)

19644 PROLONGED IRRADIATION OF DILUTE AQUEOUS SOLUTIONS OF REDOX COUPLES. Airey, P. L. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). J. Chem. Soc., Faraday Trans., I; 69: No. 1, 70-81 (1973).

On prolonged irradiation, the potential of an inert electrode immersed in aqueous solutions of a wide range of redox couples assumes a steady value (equivalent redox potential, ERP), which is determined in some cases by hydrogen peroxide and in others by the redox couple. Irradiation of arbitrary concentrations of these redox couples leads to net oxidation or reduction according to whether the equivalent redox potential is greater or less than the equilibrium potential of the couple. A theory is proposed, which defines the conditions under which the equivalent redox potential is established and predicts that when it is redox controlled, equivalent redox potential = $E(H_2O_2) - A$, where A is 24 mV for ^{60}Co γ radiation and -1.8 mV for ^{210}Po α particles ($0 < pH < 2$). The theory predicts that the equivalent redox potential is independent of the nature of the redox couple and of the intensity of the radiation; it also explains why the equivalent redox potential is not established on prolonged irradiation of redox dyes. (auth)

19645 RADIATION CHEMICAL STUDY OF THE REACTION OF Ni^+, Co^+, and Cd^+ with N_2O. Evidence for the Formation of a Hyperoxidized State by Oxygen Atom Transfer. Buxton, G. V.; Dainton, F.; McCracken, D. R. (Cookridge High Energy Radiation Research Centre, Leeds, Eng.). J. Chem. Soc., Faraday Trans., I; 69: No. 1, 243-254(1973).

Reaction of the hyper-reduced metal ions Ni^+, Co^+, and Cd^+ with N_2O produces N_2 and a hyperoxidized state M(III) of the metal ion by oxygen atom transfer. When formate is present a chain reaction occurs showing that CO_2^- reduces M^{2+}, and that M(III) reacts with formate ion to produce CO_2^-. Detailed studies of the chain reaction kinetics show that M(III) exists in at least two forms, one probably being a hydrolysis product of the other. With nickel (and probably cadmium) M(III) is not stable and is either chemically similar to the hydroxyl radical or is produced on hydrolysis. With cobalt, a long-lived (hours) Co(III) state is formed, which may be $Co(OH)_3$. (auth)

19646 PHOTOLYSIS AND THE RADIOLYSIS OF ACETONE. Lin, L. J. Washington, DC; American Univ. (1972). 83p. University Microfilms Order No. 73-1349.

Thesis (Ph.D.).

The photolysis of acetone-d_0 and of acetone-d_0 and acetone-d_6 mixtures was investigated at 1470 Å, 1236 Å and 1048-67 Å. Carbon monoxide, ethane, hydrogen and methane are major products. The quantum yield of ethane decreases with diminishing wavelength, while the quantum yield of hydrogen increases with diminishing wavelength. The production of H atoms and H_2 molecules by the decomposition of methyl radicals is found to be significant at 1236 Å and 1048 to 67 Å. Intramolecular carbene insertion and radical–molecule reaction are proposed to be the mechanisms for the formation of ethylene in the far ultraviolet region. In the pulse radiolysis as well as in the γ radiolysis, the G-values of the decomposition products from acetone-d_0 and from acetone-d_0 and acetone-d_6 mixtures are determined. (Diss. Abstr. Int., B)

19647 ELECTRON SPIN RESONANCE STUDY OF RADICAL ANIONS FROM AROMATIC CARBOXYLIC ACIDS. Neta, P.; Fessenden, R. W. (Carnegie-Mellon Univ., Pittsburgh). J. Phys. Chem.; 77: No. 5, 620-625(1 Mar 1973).

Radical anions produced by the reaction of hydrated electrons with benzoic, phthalic, isophthalic, terephthalic, trimesic, pyromellitic, mellitic, and biphenyldicarboxylic acids in aqueous solutions were studied by ESR. Solutions containing the aromatic compound together with a scavenger for OH radicals were irradiated by 2.8-MeV electrons while flowing through the ESR cavity and the spectra were recorded under steady-state conditions. The acid-base properties of the radicals were examined and in most cases several different stages of protonation were identified. All protonations of the radical anions were found to take place on the carboxyl groups and not on the ring. The loss of the last dissociable proton from each electron adduct was found to occur at a pH much higher (at least 4 units) than in the case of the parent molecules. The presence of two ortho carboxyl groups was found to result in a strong hydrogen-bonded bridge which, in the case of phthalate, does not dissociate even at pH 14. (auth)

19648 ELECTRON SPIN RESONANCE STUDY OF RADICALS PRODUCED BY ONE-ELECTRON REDUCTION OF PYRIDINES. Neta, P. (Carnegie-Mellon Univ., Pittsburgh). Radiat. Res.; 52: No. 3, 471-480(Dec 1972).

Radicals produced in irradiated aqueous solutions of carboxy and N-methyl derivatives of pyridine were studied by the in situ radiolysis steady-state ESR technique. All solutions contained other efficient OH scavengers so that only radicals produced by reaction of the pyridines with e_{aq}^- were observed. The electron adducts initially produced were found to undergo protonation on the ring nitrogen (if not methylated) to produce pyridinyl radicals. Protonation occurred rapidly both in neutral and strongly alkaline solutions, which indicates that a molecule of water rather than H^+ is involved in the process. The pK of the ring NH group of the pyridinyl radicals was above 13 in all cases examined. The ortho and para carboxy derivatives were found to produce pyridinyl radicals which are longlived as compared to the unsubstituted or meta carboxy compounds. The higher stability is probably a result of increased conjugation in the case of ortho and para derivatives, which is also expressed by their effect on the spin density on the ring. (auth)

19649 ALTERNATING CURRENT CONDUCTIVITY METHOD FOR STUDIES OF PULSE RADIOLYSIS IN AQUEOUS SOLUTIONS. Determination of the State of Ionization of Several e_{aq}^- Adducts. Lilie, J.; Fessenden, R. W. (Carnegie-Mellon Univ., Pittsburgh). J. Phys. Chem.; 77: No. 5, 674-677(1 Mar 1973).

An ac method for detecting conductivity changes in aqueous solution produced by pulse radiolysis is described. This method is applicable with constant sensitivity to solutions of up to 10^{-2} M of ionic solute and hence can be used in the range pH 2 to 12. The sensitivity corresponds to a signal-to-noise ratio of 10 for a product H^+ ion concentration of 10^{-6} M. The response time is <2 μsec. Initial applications described here are to the radicals formed by scavenging of e_{aq}^- by the pairs of compounds o- and p-nitrophenol, maleate–fumarate, and phthalate–terephthalate. In each case it is demonstrated that the e_{aq}^- adduct of the first member of the pair retains an otherwise dissociable proton at pH > 11 while the radical formed from the second member of the pair is essentially fully dissociated at pH 11. In the cases of fumarate and terephthalate a decrease in the conductivity change is found at lower pH which can be interpreted in terms of the equilibrium for dissociation of the final proton to give the trianion. The pK values are 10.7 and 10.1, respectively. The results are in agreement with ESR data on these systems and demonstrate the unusual stability of the proton in those radicals which can form an intramolecular hydrogen bond. (auth)

19650 ELECTRON–ELECTRON DOUBLE RESONANCE OF IRRADIATED SINGLE CRYSTALS OF ZINC ACETATE AND MALONIC ACID. The Influence of Nuclear Spin Exchange. Kispert, L. D.; Chang, K.; Bogan, C. M. (Univ. of Alabama, Tuscaloosa). J. Phys. Chem.; 77: No. 5, 629-633(1 Mar 1973).

Electron–electron double resonance (ELDOR) spectra of the CH_2COO^- radical in irradiated single crystals of zinc acetate and the CH_2COOH radical in irradiated malonic acid were obtained over a temperature range from -100 to $+50$°C. A maximum in the ELDOR intensity of the allowed lines was observed at -70° for CH_2COO^- and at 0°C for CH_2COOH. A maximum in the intensity of the forbidden ELDOR lines was observed approximately 50°C below the maximum intensity of the allowed lines. The qualitative aspects of the temperature dependence of the ELDOR spectra of CH_2COO^- and CH_2COOH can be explained in terms of the correlation times of the nonadiabatic spin exchange process. (auth)

19651 REDUCTION OF MERCURIC CHLORIDE BY HYDRATED ELECTRONS AND REDUCING RADICALS IN AQUEOUS SOLUTIONS. Formation and Reactions of HgCl. Nazhat, N. B.; Asmus, K. D. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). J. Phys. Chem.; 77: No. 5, 614-620(1 Mar 1973).

The reduction of $HgCl_2$ to Hg_2Cl_2 in aqueous solutions was investigated by optical absorption and conductivity pulse radiolysis. The first step is a dissociative electron capture yielding Cl^- and HgCl. The following rate constants were obtained: $k(e^-_{aq} + HgCl_2) = (4.0 \pm 0.3) \times 10^{10}$ M^{-1} sec^{-1}; $k(H\cdot + HgCl_2 = (1.0 \pm 0.5) \times 10^{10}$ M^{-1} sec^{-1}; $k((CH_3)_2COH + HgCl_2) = (2.0 \pm 0.2) = 10^9$ M^{-1} sec^{-1}. HgCl absorbs in the uv with absorption maxima at 330 (ϵ_{330} 2.3×10^3 M^{-1} cm^{-1}) and 245 nm (ϵ_{245} 7.5×10^3 M^{-1} cm^{-1}). HgCl dimerizes to Hg_2Cl_2 with $2k = (8.0 \pm 0.5) \times 10^9$ M^{-1} sec^{-1}, reacts with oxygen with $k = (1.0 : 0.3) \times 10^9$ M^{-1} sec^{-1}, transfers an electron to tetranitromethane with $k = (4.5 \pm 0.3) \times 10^9$ M^{-1} sec^{-1}, and undergoes a fast reaction with the hydroxyl radical, $k \approx 10^{10}$ M^{-1} sec^{-1}. The yield of Hg_2Cl_2 precipitate was measured in γ-irradiated solutions of mercuric chloride. In the presence of OH radical scavengers $G(Hg_2Cl_2) = \frac{1}{2}G(HgCl)$. Much less precipitate is formed in the absence of OH radical scavengers. This is explained in terms of a reoxidation of Hg_2Cl_2 (formed by dimerization of HgCl) by hydroxyl radicals. Mechanistic details of $HgCl_2$ reduction are discussed. Information was also obtained on the hydrolysis and dissociation equilibrium of mercuric chloride. (auth)

19652 IONIC YIELDS IN METHANOL MEASURED BY CONDUCTOMETRIC PULSE RADIOLYSIS. Lilie, J.; Chaudhri, S. A.; Mamou, A.; Graetzel, M.; Rabani, J. (Hahn-Meitner-Istitut fuer Kernforschung, Berlin). J. Phys. Chem.; 77: No. 5, 597-600(1 Mar 1973).

Radiation yields of ions were measured by pulse radiolysis in methanol solutions containing benzyl chloride, using an ac conductometric method. For the solvated electron a yield of $G(e^-_{sol}) = 1.8 \pm 0.2$ was measured with benzyl chloride concentrations of 1 to 10 mM. Water has no effect on the electron yield. For the CH_3O^- a yield of $G = 0.35 \pm 0.15$ was measured. (auth)

19653 RADIATION-INDUCED HOMOLYTIC AROMATIC SUBSTITUTION. I. Hydroxylation of Nitrobenzene, Chlorobenzene, and Toluene. Eberhardt, M. K.; Yoshida, M. (Puerto Rico Nuclear Center, San Juan). J. Phys. Chem.; 77: No. 5, 589-597(1 Mar 1973).

The radiolysis of aqueous solutions of nitrobenzene, chlorobenzene, and toluene was investigated. The effect of O_2 and N_2O on the isomer distribution was studied. In presence of O_2 a substantial increase in the yield of phenols was observed as expected for a homolytic substitution. Results indicate a selectivity in the disproportionation step. Evidence is presented for the formation of p-nitrophenol by a mechanism involving the nitrobenzene anion radical. A change in isomer distribution of nitrophenols in presence of N_2O as compared to deaerated or oxygenated solutions indicates the involvement of a more nucleophilic species like O^- or N_2O^- in the hydroxylation reaction. In the case of chlorobenzene, phenol was formed in addition to the chlorophenols. In deaerated toluene solutions N_2O produced a three- to fourfold increase in the total yield of substituted phenols, but no change in isomer distribution was observed. On the other hand, O_2 produced a significant change in isomer distribution particularly in the case of toluene. The ratio of G(bibenzyl) : G(total cresols) was found to increase in going from an argon-saturated to N_2O-saturated solution of toluene. This indicates the involvement of a nucleophilic species like O^- or N_2O^-. Evidence for a direct displacement of chlorine by OH radical is presented. The experimental results are interpreted on the basis of SCF–MO (CNDO-2 and INDO) calculations. (auth)

19654 FORMATION OF OXYGEN-CONTAINING PRODUCTS IN THE RADIOLYSIS OF CYCLOHEXANE SOLUTIONS OF NITROUS OXIDE. Hatano, Y.; Takeuchi, K.; Takao, S. (Tokyo Inst. of Tech.). J. Phys. Chem.; 77: No. 5, 586-589(1 Mar 1973).

Oxygen-containing products in the radiolysis of cyclohexane solutions of N_2O were quantitatively measured and found to be H_2O and $c\text{-}C_6H_{11}OH$, denoted by ROH. The yield of ROH, most of which is H_2O, is in good agreement with that of N_2. This finding shows that the decomposition of N_2O in liquid cyclohexane finally leads to N_2 and ROH with the ratio of one to one. A further study of the correlation of the nitrogen yield with the decrement in the hydrogen yield was made in order to estimate the nitrogen yield per electron captured by N_2O. Possible processes on the decomposition mechanism of N_2O in the radiolysis of cyclohexane solutions are discussed. (auth)

19655 RADIATION-INDUCED DECOMPOSITION OF RADIOIODINE-LABELLED 3-IODO-L-TYROSINE. Appleby, A.; Umfrid, R. P. (Rutgers–The State Univ., New Brunswick, NJ). J. Label. Compounds; 8: No. 3, 415-430(1972).

In investigating the radiolytic decomposition of 3-iodo-L-tyrosine (MIT) it was found: that, by studying the effects of dissolved argon, nitrous oxide, and hydrogen, e^-_{aq} is the reactive intermediate of greatest interest in choosing a protector of the labelled compound; that O_2/ethanol and N_2O/ethanol are both good combinations for the purpose of protecting the substrate; and that in dilute solutions of MIT, with adequate protector present, high specific activity compound should be no more prone to radiation-induced self-decomposition than is a compound labelled at a lower specific activity. (auth)

19656 DEGRADATION REACTION OF POLYMERS BY RADIATION. Kagiya, T. (Kyoto Univ.); Hagiwara, M. Kagaku No Ryoiki; 26: No. 8, 617-626(Aug 1972). (In Japanese).

Review is made on the radiation chemistry of high polymers and the application of radiation to polymer degradation reaction. The radiations used most often are γ ray from ^{60}Co and ^{137}Cs, α ray from ^{210}Po, and β ray from ^{85}Kr. Energy of these rays are about a million eV. The energy required to cut chemical bonding in the high polymers is about 2 to 6 eV. Therefore, the energy of radiation is satisfactorily large to cause chemical reaction. When polymers are irradiated in vacuum, C–C bonding in main chain and C–H bonding in side chain are easily cut off, and monomers or molecules of smaller molecular weight are formed. Bridging also occurs and results in the formation of 3-dimensional network polymers, which are insoluble in various solvents. In order to cause the degradation of polymers, it is necessary to facilitate the cutting of the main chain. One example of this degradation is the chain degradation reaction. The degradation is affected by the atmosphere. For instance, polyethylene oxide performs bridging reaction in vacuum, but it degrades in air. Irradiation of substances in the presence of foreign material is also important from the technical viewpoint. The irradiation by γ ray of methylacetylene in the presence of 10% tetrafluoroethylene gives carbonyl radical. With the progress of oxidation, the oxidation by the light of 312 μ becomes extensive. This promotion of the oxidation is attributable to the formation of the carbonyl radical in the polymer, which is formed by the oxidation. (Japan)

19657 SYNTHESES OF OXYGEN-CONTAINING HALOGENATED COMPOUNDS. I. Gamma-induced Addition Reaction of Aliphatic Alcohols to Tetrachloroethylene. Yumoto, T. (Government Industrial Research Inst., Nagoya, Japan); Matsuda, T. Nagoya Kogyo Gijutsu Shikensho Hokoku; 21: No. 7, 181-190 (Jul 1972). (In Japanese).

Methyl, ethyl, propyl, and butyl alcohols were found to add to tetrachloroethylene by irradiation with γ-rays. Saturated and unsaturated 1 : 1-adducts, whose general formulas were $CHCl_2CCl_2C(R_1)(R_2)-OH$ and $CCl_2{=}CClC(R_1)(R_2)-OH$, were obtained. Effects of the molar ratio of reactants, dose rate, total dose, and temperature on this reaction were studied. The optimum conditions were found to be: (ROH): $(CCl_2{=}CCl_2) = 4 : 1$, dose rate about 4×10^5 r/hr, and total dose 4.3 to 7.0 Mr. Most of the alcohols were found to be consumed at rates nearly proportional to dose rate, but in the case of ethyl alcohol, the rate was found to be nearly proportional to the square root of the dose rate. The yield of the adduct decreased in the order: ethyl > n-propyl > isopropyl > sec-butyl > methyl > n-butyl > isobutyl. As the total dose increases, the total yield becomes higher but the ratio of unsaturated to saturated adducts becomes larger. (auth)

19658 DEVELOPMENT AND UTILIZATION OF ^{85}Kr. Kasamatsu, T. (Japan Atomic Energy Research Inst., Takasaki). Genshiryoku Kogyo; 18: No. 9, 34-38(Sep 1972). (In Japanese).

After considering briefly the conventional uses of ^{85}Kr, its usage in radiation chemistry is described. Since ^{85}Kr is mainly a β emitter, it is attractive in the radiation chemistry field due to ease in shielding and high energy usage efficiency. (DHM)

Radiochemistry and Nuclear Chemistry

Refer also to abstracts 19525, 19560, and 19610.

19659 CONSIDERATIONS ON THE INVESTIGATION LEVEL CONCEPTION OF AIR MONITORING. Ringel, V.; Rossbander, W. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Isotopenpraxis; 8: No. 6, 226-230(Jun 1972). (In Germany).

For accidental activity releases monitoring a routine room air monitoring technique is proposed for inclusion in the protection survey system of radiochemical laboratories. It must meet the following demands: continuous operation, early signalling of undue activity concentration, and stopping of incorporation monitoring when activity concentration has fallen below alarm value. This technique corresponds with the investigation level concept of the ICRP. Introduction of the investigation level concept into routine monitoring work is only possible with evaluation of the results of

air monitoring according to maximum permissible concentration. (auth)

19660 APPLICATIONS OF THE MOESSBAUER EFFECT IN RADIOCHEMISTRY. Friedt, J. M.; Danon, J. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Radiochim. Acta; 17: No. 4, 173-190(Nov 1972).

The applications of the Moessbauer spectroscopy in the various fields of radiochemistry are reviewed. After a brief introduction to the theory of Moessbauer spectroscopy, some radiolysis experiments in solids are described. The new insights obtained with this technique in the understanding of the chemical effects of nuclear transformations are then discussed. The last sections describe the contribution to radiochemical techniques (surface studies, ion exchange resins, solvent extraction and frozen solution problems, isotopic exchange in solids, etc....). Finally, the contribution to the chemistry of the heaviest elements is briefly reported. (auth)

Hot-Atom Chemistry

19661 ESTIMATION OF OPTIMAL CONDITIONS FOR REACTIONS OF HOT INTERACTION. Tsetskhladze, T. V.; Cherkezishvili, L. I. pp 66-74 of Yaderno-Khimicheskie Yavleniya v Tverdykh Telakh. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian).

Optimal conditions for reaction of tritium hot atoms with gaseous targets are provided using the reaction $^{3}He(n,p)T$ as the source of tritons. In the condensed phase and for interaction taking place on solid surfaces, it is more profitable to use the reaction $^{6}Li(n,\alpha)T$. However, in both cases, there are great losses of tritons caused by seepage of ^{3}He through quartz in the first case and by absorption of tritons in lithium salt and target in the second one. The losses of tritons are measured and optimal conditions for reactions of hot labeling with tritium are estimated. (auth)

19662 REACTIONS OF RECOIL IODINE FORMED BY THE $^{123}Xe \rightarrow {}^{123}I$ SYSTEM WITH SIMPLE HYDROCARBONS. Effects of Additives on the Reactivity. Loberg, M. D.; Welch, M. J. (Washington Univ., St. Louis). J. Amer. Chem. Soc.; 95: No. 4, 1075-1082(21 Feb 1973).

Iodine atoms formed by the system $^{123}Xe \rightarrow {}^{123}I$ were treated with simple hydrocarbons, and the reactivity with methane studied as a function of various additives. Although some additives such as ethane, neopentane, and xenon reduce the organic yield with methane, others such as nitrogen, krypton, argon, and neon were observed to increase the yield. This effect by additives cannot be explained simply by the direct reaction of two or more excited states of iodine atoms of I^{+}. A model involving molecular ion complexes was developed which is consistent with the observed data. In the presence of additives, it is postulated that the reactive species is a molecular ion of the form AI^{+} where A can be CH_4, Xe, Ne, Ar, Kr, or N_2. It is this species that undergoes an ion-molecular reaction to form organic products. (auth)

19663 REACTIONS OF ACCELERATED CARBON IONS AND ATOMS. Lemmon, R. M. (Univ. of California, Berkeley). Accounts Chem. Res.; 6: No. 2, 65-73(Feb 1973).

Reactions of ^{14}C ions with benzene were studied using first a mass spectrometer and then an ion accelerator. Products formed, effects of $^{14}C^{+}$ kinetic energy, effects of neutralizing the $^{14}C^{+}$ ion, distribution of activity in products, mechanisms of product formation, and other compounds irradiated are discussed. (41 references). (MCG)

19664 EFFECT OF IODINE EXCHANGE ON THE YIELD OF SZILARD–CHALMERS REACTION IN METHYL IODIDE. Svoboda, K. (Inst. of Nuclear Research, Rez, Czech.). Isotopenpraxis; 8: No. 9, 351-356(Sep 1972). (In German).

A simplified relation for the retention of the Szilard-Chalmers reaction as a function of exchange rate, iodine concentration, irradiation time, and hold-up time up to separation is derived for the system methyl iodide–iodine with the aid of differential equations taking into account the exchange process. The measured retention is investigated as a function of the added quantity of iodine, the irradiation time and the hold-up time. The experiments confirmed the pseudomonomolecular mechanism of iodine exchange in this system. Previously published works are discussed on the basis of theoretical and experimental data. (auth)

19665 CHEMICAL BEHAVIOR OF SHORT-LIVED TIN FISSION PRODUCTS. Lin, C. C.; Wahl, A. C. (Washington Univ., St. Louis). J. Inorg. Nucl. Chem.; 35: No. 1, 1-9(Jan 1973).

The fractions of 40 min ^{123}Sn, 9.6 min ^{125}Sn, 4.4 min ^{127}Sn, 2.5 min ^{129}Sn, 7.4 min ^{129}Sn, and 40 sec ^{132}Sn formed as Sn(II) in aqueous 1 M HCl from thermal-neutron-induced fission of ^{235}U were determined to be 0.50 ± 0.05, 0.69 ± 0.06, ~0.7, ~0.7, and ~0.65, respectively. The fraction as Sn(II) from β-decay increases with mass number, possibly because of increasing recoil energy, and overlaps the fraction as Sn(II) of 0.6 to ~0.7 for independently formed tin fission products. Thus, oxidation states are not useful measures of fractional independent yields for tin fission products. The fraction as Sn(II) for a number of the longer-lived tin fission products is essentially independent of temperature in the range of ~0° to ~25°C. (auth)

19666 FORMATION OF ^{32}P-LABELLED POLYPHOSPHATES IN REACTOR-IRRADIATED SOLUTIONS OF ORTHOPHOSPHATE. Fenger, J.; Pagsberg, P. B. (Danish Atomic Energy Commission, Risoe). J. Inorg. Nucl. Chem.; 35: No. 1, 31-38(Jan 1973).

Aqueous solutions of potassium orthophosphate were reactor irradiated and analyzed by electrophoresis. The resulting distributions of ^{32}P-activity in phosphorus oxyanions resemble the ones obtained with reactor-irradiated solid phosphates. Even in dilute solutions, polymers are formed; their total yield increases with the concentration of the irradiated solution and varies in a complicated way with the pH. These observations and some experiments with addition of radical scavengers indicate that oxidation of the ^{32}P-recoils by OH-radicals is an important step in the polymerization. It is suggested that the actual formation of a P–O–P bridge takes place as an addition of a Lewis acid to a lone pair of electrons on a phosphate ion. (auth)

19667 INFLUENCE OF RADIATION AND ANNEALING ON THE RETENTION IN NEUTRON-ACTIVATED POTASSIUM PERMANGANATE. van Herk, G. Jr.; Aten. A. H. W. Jr., (Inst. voor Kernphysisch Onderzoek, Amsterdam). Radiochim. Acta; 17: No. 4, 214-217(Nov 1972).

From results of a study of the effects of irradiation dose and preheating on the retention of ^{56}Mn and ^{54}Mn in potassium permanganate, it was concluded that irradiation with fast neutrons of the cyclotron affects mainly the high temperature annealing processes (around 170°C) and that preheating affects mainly or at least to a large part the low temperature contributions. (DHM)

19668 HYDROXIDE COLLECTORS IN RADIOCHEMISTRY. VII. PECULIARITIES OF THE LINEARIZATION OF COMPETITIVE ISOTHERMS. Egorov, Yu. V. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 192-196(1972).

Translated from Radiokhimiya; 14: No. 2, 183-188(1972).

In the Ratner model of an ionic-inhomogeneous electrical double layer on the surface of hydroxide collectors, equivalent to the oxyacid model the following were considered: the primary layer represents hydroxyl ions and anions of the background electrolyte; the secondary layer represents hydrogen ions and cations of the background electrolyte. It was assumed that sorption of the potential determining ions obeys an equation of the virial type. Within the framework of these assumptions, it was shown theoretically that: (a) the apparent change of the ion of the microcomponent–sorbate, which is the slope of the log ϵ versus pH isotherm, should be less than the actual value; (b) this slope decreases with increasing concentration of the background electrolyte; and (c) the modulus of the slope of the desorption (competitive) isotherm should be smaller than the ratio of the charges of the cations of the microcomponent and the background electrolyte. (auth)

19669 CHEMICAL BEHAVIOR OF RADIOACTIVE ATOMS OF RHENIUM, FORMED IN CERTAIN INORGANIC COMPOUNDS OF IRIDIUM IN IRRADIATION WITH 660-MeV PROTONS. Zaitseva, N. G.; Ivanovich, E. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 331-338(1972).

Translated from Radiokhimiya; 14: No. 2, 319-327(1972).

The chemical behavior of the radioactive rhenium atoms formed in the irradiation of certain inorganic compounds of iridium with 660 MeV protons was studied. The results showed that the yield of radiorhenium in the heptavalent form depends on the chemical composition of the irradiated compound. In the irradiation of sodium and ammonium salts of iridium hexachloro-complexes, containing and not containing water of crystallization, it was found that the yield of Re(VII) increases in the following order: $Na_2IrCl_6 \cdot 6H_2O > (NH_4)_2IrCl_6 > Na_2IrCl_6$; $Na_3IrCl_6 \cdot 12H_2O > (NH_4)_3IrCl_6 \cdot H_2O > Na_3IrCl_6$. It was shown that radiation and thermal annealing of the irradiated anhydrous salt Na_2IrCl_6 caused oxidation of radioactive rhenium. The results obtained are discussed on the basis of the mechanism of the interaction of rhenium recoil nuclei with defects of the crystal lattice and radiolysis products arising under the action of high-energy protons. In a comparison of the behavior of rhenium recoil nuclei formed in the reactions Re(p, pxn)Re and Ir(p, 3pxn)Re, a large difference was detected, which can be explained by a different nature of the reactions occurring in the isotopic and nonisotopic lattices of the irradiated compounds. (auth)

19670 STABILIZATION OF RECOIL AND DOPANT MANGANESE AS PERMANGANATE IN POTASSIUM PERMANGANATE–POTASSIUM PERCHLORATE MIXED CRYSTALS. Owens, C. W.; Lecington, W. C. (New Hampshire Univ., Durham). J. Inorg. Nucl. Chem.; 35: No. 2, 685-687(Feb 1973).

The permanganate yields of dopant $^{54}Mn(II)$ in γ-irradiated $KClO_4-KMnO_4$ mixed crystals and of recoil ^{56}Mn in reactor irradiated $KClO_4-KMnO_4$ mixed crystals were compared and are found to be in good quantitative agreement at all compositions. Observations are made about the mechanism of stabilization of manganese as permanganate. (auth)

19671 RELATIVE BOND DISSOCIATION ENERGIES OF SILICON–HYDROGEN BONDS IN METHYLSILANES AS ESTIMATED FROM RECOIL TRITIUM ABSTRACTION YIELDS. Hosaka, A.; Rowland, F. S. (Univ. of California, Irvine). J. Phys. Chem.; 77: No. 5, 705-708(1 Mar 1973).

The relative DT yields per Si–D bond for the abstraction of D by recoil tritium atoms were measured as 4360 for $(CH_3)_3SiD$, 3790 for $(CH_3)_2SiD_2$, and 3680 for CH_3SiD_3, as compared with yields per C–D bond of 2380 for $(CH_3)_3CD$ and 1190 for CH_3CD_3. The substantially higher yields from Si–D bonds than from C–D bonds suggest that all Si–D bond dissociation energies are appreciably less than 90 kcal/mol. The Si–D bond dissociation energies in CH_3SiD_3 and $(CH_3)_2SiD_2$ are each estimated to be approximately 2 to 3 kcal/mol higher than that in $(CH_3)_3SiD$. These differences are substantially smaller than those found with the corresponding C–D bonds in alkanes. (auth)

19672 ANNEALING OF ^{51}Cr AND ^{60}Co RECOILS IN NEUTRON IRRADIATED MIXED CRYSTALS OF Cr(3) AND Co(3) COMPLEXES. Lazzarini, A. L. F.; Lazzarini, E. (Politecnico, Milan). J. Inorg. Nucl. Chem.; 35: No. 2, 681-684(Feb 1973).

A study is reported of the isochronal annealing curves of ^{51}Cr and ^{60}Co recoil species produced by neutron irradiation of mixed crystals (solid solutions) of cobalt and chromium tris(ethylenediamine) nitrate $[Co_{0.2}Cr_{0.8}en_3](NO_3)_3$. (auth)

Properties of Radioactive Materials

Refer also to abstracts 19512, 19558, 19655, and 20194.

19673 (ANL–7976) CHEMICAL ENGINEERING DIVISION THERMOCHEMICAL STUDIES SEMIANNUAL REPORT, JULY–DECEMBER 1972. Hubbard, W. N.; O'Hare, P. A. G.; Johnson, G. K.; Ader, M.; Vogel, R. C. (Argonne National Lab., Ill.). Jan 1973. Contract W-31-109 eng-38. 18p. Dep. NTIS.

Standard enthalpies of formation at 298°K were determined (most values are of a preliminary nature) as follows. Values for cesium and rubidium molybdate were determined by solution calorimetry to be ΔHf^0 (Cs_2MoO_4, c) = $-362.0_0 \pm 0.1_1$, and ΔHf^0 (Rb_2MoO_4, c) = ~–356 kcal mol^{-1}. These compounds are important in studies of the interactions between oxide fuels and their fission products. Similar determinations made for α-Na_2UO_4 and $NaUO_3$, both of which compounds are of interest in LMFBR fuel-coolant studies, gave ΔHf^0 (Na_2UO_4, α) = ~ – 445.5 ± 0.9 and ΔHf^0 ($NaUO_3$, c) = ~–374 kcal mol^{-1}. Selected enthalpies of formation were determined for the molybdenum and vanadium carbide systems by fluorine bomb calorimetry. These studies have yielded ΔHf^0 ($MoC_{0.496}$, α) = ~–5.53 and ΔHf^0 ($MoC_{0.642}$, α) = ~–3.66 kcal mol^{-1}. Preparatory to making measurements on several carbides of vanadium, the enthalpy of formation of VF_5 was determined; it was found to be ΔHf^0 (VF_5, g) = ~–343.50 ± 0.21 kcal mol^{-1}. Preparations are being made for fluorine bomb calorimetric measurements on U_2Si, a compound of general interest, and Li_2Se, of interest in the lithium-chalcogen cell development program. Total Hartree–Fock energies of AsF and AsF^+, computed at the experimental internuclear separation of the parent species, lead to 11.8 eV for the vertical ionization potential of AsF. (auth)

19674 (NIIAR-P-122) SPECTROPHOTOMETRIC STUDY OF ACTINIDE ELEMENT ION COMPLEXING AND SOLVATION. 4. NATURE OF URANIUM(IV) AND NEPTUNIUM(IV) INTERMEDIATE FORMS IN NITRATE SOLUTIONS. Rykov, A. G.; Blokhin, N. B.; Vasil'ev, V. Ya. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1971. 20p. (In Russian). INIS.

The intermediate form of uranium(IV) and neptunium(IV), predominating in solutions with concentrations 1 to 8 M in NO_3^-, is not a nitrate complex of the type $M^{4+}(NO_3)_n^-$ (n < 6), but a hydrate. An equation is proposed that describes the transition of M(IV) from its initial form to the intermediate. The influence of H^+ and ClO_4^- ions and of non-electrolytes on the yield of the intermediate form was elucidated. (tr-auth)

19675 (NYO-1669-4) HELIUM AND ARGON IN ROCKS AND MINERALS. Annual Progress Report No. 4. Kulp, J. L. (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory). 10 Jan 1958. Contract AT(30-1)-1669. 100p. Dep. NTIS.

Age estimations using helium and argon are discussed. Methods and equipment developed are described. The origin of the present isotopic composition of rare gases in the atmosphere is reviewed. (MCG)

19676 RADIOACTIVE LABELING KIT. Kubiatowicz, D. O. (to Minnesota Mining and Mfg. Co.). U. S. Patent 3,707,353. 26 Dec 1972. Filed 26 Mar 1970.

A single-unit labeling kit for radioactively labeling biodegradable microparticles for medical diagnosis and the like comprises, generally, a container having at least one open end; a porous filter plate mounted within the container separating the container into first and second compartments; a plurality of biodegradable microparticles in the first compartment; a solid source of hydrogen ion in the second compartment; a reagent tablet in the first compartment, the tablet comprising a reducing reagent and a nonreactive, nontoxic wetting agent to aid in forming a suspension of the microparticles when a liquid is introduced into the container; and means to temporarily seal the open end of the container, such means capable of receiving a syringe needle for placing a liquid in the container and for the removal of radioactively labeled microparticles. The microparticles are labeled by introducing a solution containing radioactive technetium into the end of the container carrying the solid source of hydrogen ion, acidifying the solution by passing it through the solid source of hydrogen ion and through the porous filter plate into the first compartment, agitating the acidified solution to suspend the microparticles and dissolve the reagent tablet, heating the container to complete the labeling reaction, cooling the container, and removing the supernatant containing unreacted radioactive elements and spent reagents, leaving the labeled microparticles behind on the porous filter plate which may thereafter be removed for use. (Official Gazette)

19677 TERNARY SYSTEM $MgCl_2-UCl_3-ThCl_4$. Desyatnik, V. N.; Mel'nikov, Yu. T.; Trifonov, I. I. (Uran Polytechnic Inst., Sverdlovsk, USSR). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 4, 95-96(1972). (In Russian).

A melting point diagram was constructed for the UCl_3-ThCl_4 system, showing a eutectic point at 30 mole % UCl_3 of 632°C and a single compound $4UCl_3 \cdot ThCl_4$ that melted incongruently at 750°C. For the system $MgCl_2-UCl_3-ThCl_4$, ten polythermal cross sections were studied, revealing a eutectic with the composition 30–19–51 mole percents at 575°C, and a peritectic point with the composition 50–30–11 mole percents at 668°C. (KSW)

19678 BINDING OF ^{99m}Tc TO VARIOUS HUMAN SERUM ALBUMINS. Perrin, J. H.; Nelson, D. A.; Tyson, I. B. (Univ. of Wisconsin, Madison). J. Pharm. Sci.; 61: No. 10, 1667-1668 (Oct 1972).

The percentage of ^{99m}technetium bound to Red Cross, Fraction V, and crystalline human serum albumin was investigated by dialysis and gel filtration. Any variation in the percentage bound seemed to be a function of the technetium–iron–ascorbic acid complex not broken down rather than of any variation in the albumins. (auth)

19679 BASIC URANYL FLUORIDES. Tsvetkov, A. A.; Seleznev, V. P.; Sudarikov, B. N.; Gromov, B. V. (Moscow Chemical-Technical Inst.). Zh. Neorg. Khim.; 18: No. 1, 12-15(Jan 1973). (In Russian).

The existence of two hydrates of a basic salt of variable composition was detected in the system UO_3-HF-H_2O: $UO_2(OH)_xF_{2-x} \cdot 2H_2O$, and $UO_2(OH)_xF_{2-x} \cdot H_2O$, where x = 0.3 to 1.2. The structures of these salts were investigated by differential thermal analysis, obtaining some thermodynamic characteristics. (tr-auth)

19680 THERMAL STABILITY OF URANYL SULFATE. Dubrovin, A. V.; Koval'chuk, V. Yu.; Dunaeva, K. M.; Ippolitova, E. A. Vestn. Mosk. Univ., Ser. II. Khim.; 13: No. 5, 603-604(1972). (In Russian).

The energy of activation for thermal decomposition of anhydrous uranyl sulfate was calculated to be 83 kcal/mol using Horowitz and Metzger equation. (auth)

19681 MOLAR ABSORPTIVITY AND STABILITY OF SOME COMPLEX COMPOUNDS OF THE BA_n FORM. Paralescu, I. (Lab. of Analytical Chemistry, Bucharest). Rev. Roum. Chim.; 15: No. 6, 901-916(Jun 1970).

The working up of the spectrophotometric data on the complex compounds of the BA_n form resulted in the possible introduction of the terms ϵ^n and $1/\epsilon^n$ for the characterization of the stability or instability of the 94 complexes which are described including

UO_2, Th, Sc, La, Nd, Ho, Ru, and Zr complexes. The identity between the obtained values and the literature data supports the validity, the utility and the extension prospects of these terms. (auth)

19682 REACTION OF DISSOLVED URANIUM(VI) FLUORIDE WITH SOLID ALKALI METAL FLUORIDES. Rak, V.; Horacek, P. (Nuclear Research Inst., Prague). Collect. Czech. Chem. Commun.; 38: No. 1, 42-45(Jan 1973). (In German).

The time dependence of the UF_6 transfer from saturated solutions in perfluordimethylcyclohexane into solid alkali metal fluorides was measured at 23, 30, 40, 50, and 60°C. It was determined that under these conditions, CsF proved to be the most effective sorbent. (tr-auth)

19683 CHEMISTRY OF THE URANYL GROUP. 5. SOME URANYL COMPLEXES WITH TRIMETHYLAMINE OXIDE. Zarli, B.; Volponi, L.; Sindellari, L. (Univ., Padua). J. Inorg. Nucl. Chem.; 35: No. 1, 231-237(Jan 1973).

Some uranyl complexes with several anionic bidentate ligands and trimethylamine oxide (L) were prepared and characterized. The diethyldithiocarbamato (DTC) and the diethyldiselenocarbamato (DSC) derivatives have the general formula UO_2X_2L (where X = DTC or DSC). An acetato complex of formula $[UO_2(OA_c)_2 \cdot L \cdot H_2O)]_2$ was also isolated. Furthermore by reaction of uranyl nitrate hexahydrate with the ligand L, two compounds were obtained of formula $UO_2(NO_3)_2 \cdot 2L$ and $UO_2(NO_3)_2 \cdot 4L$, respectively. As expected the first complex has an eight-coordinated configuration with the two nitrato-groups both chelate to the uranium atom; for the other complex a salt-like formulation is suggested from ir spectral evidences. In addition the preparation and the properties of $UO_2(DSC)_2 \cdot (C_6H_5)_3PO$ and $UO_2(DSC)_2 \cdot (C_6H_5)_3AsO$ are also reported. (auth)

19684 PREPARATION OF CURIUM OXYSULFATE AND CURIUM OXIDE BY RESIN CALCINATION. Hale, W. H.; Mosley, W. C. (Savannah River Lab., Aiken, SC). J. Inorg. Nucl. Chem.; 35: No. 1, 165-171(Jan 1973).

Calcination of Cm^{3+}-form Dowex 50W-X8 resin in air or oxygen yields $Cm_2O_2SO_4$ at 900°C and Cm_2O_3 at 1175°C. A stable compound, probably $Cm_2(SO_4)_3$, exists at 760° to 870°C. The ionic radius of Cm^{3+} in $Cm_2O_2SO_4$ is 0.980Å. Alpha radiation damage in $^{244}Cm_2O_2SO_4$ causes loss of structure in ~3 days and partial degradation to CmO_2 in ~8 days. (auth)

19685 CHEMICAL CONSEQUENCES OF THE CONVERTED ISOMERIC TRANSITION OF ^{129m}Te IN SOME INORGANIC TELLURIUM COMPOUNDS. Lebedev, R. A.; Babeshkin, A. M.; Nesmeyanov, A. N. Vestn. Mosk. Univ., Ser. II. Khim.; 13: No. 6, 659-662(1972). (In Russian).

The stabilized form of ^{129}Te produced by the isomeric transition of ^{129m}Te in the matrices H_6TeO_6(monoclinic), $(NH_4)_2H_4TeO_6$, $Na_2H_4TeO_6$, $PbTeO_4$, TeO_2 (tetragonal, and $Te(SCN_2H_4)_4Cl_2 \cdot 2H_2O$ were investigated on ^{129}I nuclei by emission nuclear gamma resonance spectroscopy (NGR). The obtained data were compared with the results of other investigations carried out by radiochemical and NGR methods. (auth)

19686 EFFECT OF URANIUM NITRATE ON IODINATION AND MOLECULAR COMPOSITION OF THYROGLOBULIN IN VITRO. Malenchanka, A. F.; Syarogin, V. V.; Valozhyn, A. I.; Dzenisyuk, M. M. (Inst. of Nuclear Energy, Minsk). Vestsi Akad. Navuk BSSR, Ser. Biyal. Navuk; No. 1, 90-94(1973). (In Belorussian).

The iodination of thyroglobulin in vitro and the influence of uranium nitrate on this process were studied. Addition of uranium to the iodizing medium increased the thyroxine synthesis, which may be the result of the oxidizing action of the uranyl ion or of complex formation of UO_2^{2+} with thyroxine and an increased concentration of I in the remaining reactive portion of the thyroxine molecule. Ultracentrifugation showed that during the iodination of thyroglobulin there was observed an increase in the sedimentation constant; the presence of uranium nitrate inhibited this process. (tr-auth)

19687 CHEMICAL EFFECTS OF THE DECAY OF ^{35}S INCORPORATED INTO AN ETHYL MERCAPTAN MOLECULE. Kanski, R.; Pluciennik, H. (Univ., Warsaw). Nukleonika; 17: No. 10, 509-520(1972). (In Polish).

Chemical effects of the disintegration of ^{35}S incorporated into the double-labelled molecules $^{14}C_2H_5{}^{35}SH$ were studied. The final products, appearing according to the reaction scheme $^{14}C_2H_5{}^{35}SH \xrightarrow{\beta^-} [^{14}C_2H_5{}^{35}SH]^+$, were detected by the radiometric isotope dilution method. It was established that in the gas phase 47 ± 3% of the primary molecular ions stabilized in the form of C_2H_5Cl. In the presence of water vapor the yield of C_2H_5Cl molecules rose to 83 ± 8%. Experimental results are discussed. (auth)

19688 STABILITY CONSTANTS OF SODIUM 4-HYDROXY-3-OXIMINOMETHYLAZOBENZENE-4'-SULPHONATE WITH SOME METAL IONS. Mohan Das, P. N.; Sunar, O. P.; Trivedi, C. P. (Univ. of Jodhpur, India). J. Inorg. Nucl. Chem.; 35: No. 1, 316-319(Jan 1973).

In continuation of earlier studies of the synthesis and chelating tendencies of sodium 4-hydroxy-3-oximinomethylazobenzene-4'-sulphonate (SHOBS) with bivalent metal ions, the stepwise stability constants of UO_2(VI), Hg(II), Pb(II), Mn(II), and Mg(II) complexes of SHOBS are reported. (auth)

19689 POLAROGRAPHIC AND COULOMETRIC REDUCTION OF ACTINIDE(4) CHLORIDE IN DIMETHYL SULPHOXIDE. Astheimer, L.; Schwochau, K. (Kernforschungsanlage, Juelich, Ger.). J. Inorg. Nucl. Chem.; 35: No. 1, 223-230(Jan 1973).

Solutions of $ThCl_4$, $PaCl_4$, UCl_4, and $NpCl_4$ in dimethyl sulfoxide were investigated by means of dc and ac polarography as well as controlled potential coulometry. For $NpCl_4$ the transitions Np(IV) → Np(III) with $E_{\frac{1}{2}}$ = 0.47 V (vs. saturated calomel electrode) and Np(III) → Np(0) with $E_{\frac{1}{2}}$ = −2.19 V were observed. UCl_4 is also first reduced to the +3 valence state with $E_{\frac{1}{2}}$ = −1.22 V; the transition to U(0) takes place with $E_{\frac{1}{2}}$ = −2.16 V. The reduction of $PaCl_4$ leads to Pa(0) in a single step with $E_{\frac{1}{2}}$ = −1.49 V; the oxidation state +3 is omitted. For $ThCl_4$ the transitions Th(IV) → Th(II) with $E_{\frac{1}{2}}$ = 1.64 V and Th(II) → Th(0) with $E_{\frac{1}{2}}$ = −2.31 V may be deduced. The ac efficiencies point to very different reversibilities of the electrode processes. (auth)

19690 PREPARATION AND CHARACTERIZATION OF PLUTONYL(6) CARBONATE. Navratil, J. D.; Bramlet, H. L. (Dow Chemical Co., Golden, CO). J. Inorg. Nucl. Chem.; 35: No. 1, 157-163(Jan 1973).

Plutonyl(VI) carbonate was precipitated at pH 4 to 7 from plutonyl(VI) nitrate solutions by the addition of alkali metal carbonates. Various precipitation conditions and precipitate washing solvents were studied. The precipitates were characterized by chemical analysis, electronic and ir spectrophotometry, thermogravimetric analysis, and x-ray diffraction techniques. The results show that under most precipitation and washing conditions, PuO_2CO_3 (.0 to 0.5) H_2O is the product. It was found isostructural with UO_2CO_3 and the lattice parameters are a = 4.80 ± 0.01, b = 9.26 ± 0.02 and c = 4.25 ± 0.01. (auth)

19691 BEHAVIORS OF NEPTUNIUM IN AQUEOUS SOLUTIONS. Stability of DTPA Complex. Chang, C. T.; Chang, M. M.; Liaw, C. F. (National Tsing Hua Univ., Hsinchu, Taiwan). J. Inorg. Nucl. Chem.; 35: No. 1, 261-264(Jan 1973).

The ion exchange behavior of Np(IV) in the presence of DTPA was investigated. The hydrogen ion activity of the solution was kept above 0.1 M. Thermodynamical data together with probable chemical species were estimated. (auth)

19692 THERMODYNAMIC FUNCTIONS OF SUBSTOICHIOMETRIC URANATES FROM CLOSED-COMPARTMENT GALVANIC CELL MEASUREMENTS. Jakes, D. (Inst. of Nuclear Research, Prague). Collect. Czech. Chem. Commun.; 38: No. 1, 1-6(Jan 1973).

Equilibrated samples of highly substoichiometric magnesium, calcium, strontium, and barium monouranates were used in testing a closed-compartment, high-temperature galvanic cell device. The partial enthalpies and entropies were determined with a high accuracy. Coulometric and stability examinations demonstrated the reliability and reproducibility of the proposed design. (auth)

19693 PHOSPHATES AND ARSENATES OF URANIUM(VI) AND NEPTUNIUM(VI). Hoffmann, G. Munich; Ludwig-Maximilians-Univ. (1972). 163p. (In German).

Thesis.

Various phosphates and arsenates of uranium(VI) and neptunium(VI) were synthetized and studied radiographically. To obtain the optimal conditions for the production of the corresponding neptunium components, a thorough study first comprised the formation of $HUO_2PO_4-4H_2O$ and $HUO_2AsO_4-4H_2O$, respectively. Treatment of the hydrogen compounds with alkali chloride solutions yielded the corresponding alkali phosphates or arsenates. In a similar fashion, the analogous compounds then were synthetized, for the first time, with neptunium(VI). Identification of the compounds was possible through comparison of the roentgen diagrams. (HBG)

19694 STUDY ON CATALYSIS BY URANIUM OXIDE AND ITS MIXED CATALYSTS. IV. Catalytic Selectivity of Uranium Oxide Catalyst for Dehydrogenation and Dehydration of Ethanol. Nozaki, F.; Inami, I. (Chiba Univ., Japan). Nippon Kagaku Kaishi; 11: No. 11, 2202-2204(1972).

The catalytic selectivity of the three uranium oxides, UO_2, U_3O_8, and UO_3, for the dehydrogenation and dehydration of ethanol was investigated using the pulse-reaction method. The catalytic activities varied initially as the injection of reactant was repeated, and then reached nearly stationary values. During the course of reaction, the uranium oxides except UO_2 were reduced to oxides of uranium of lower oxidation states. An interesting relationship was found between the oxidation state of uranium and the catalytic selectivity. (auth)

19695 THORIUM TETRACHLORIDE AND URANYL SULFATE COMPLEXES WITH PHENYLHYDRAZINE AND BENZIDINE. Rahman, S. M. F.; Ahmad, J.; Haq, M. M. (Aligarh Muslim Univ., India). Z. Anorg. Allg. Chem.; 392: No. 3, 316-320(Oct 1972).

Phenylhydrazine (Ph) and benzidine (B) form complexes with thorium tetrachloride and uranyl sulfate of the general composition: $[ThPh_4]Cl_4$, $[ThB_2Cl_2]Cl_2$, $[UO_2Ph]SO_4$, and $[UO_2B(THF)]SO_4$ (THF = tetrahydrofuran). The compounds were isolated, analyzed, and their molar conductivities were determined in dimethyl sulfoxide and dimethylformamide. The nature of coordination was discussed in the light of ir spectral assignments. (auth)

19696 COLLOIDAL BEHAVIOR OF CARRIER-FREE RADIOPHOSPHATE IN AQUEOUS SOLUTIONS. Benes, P.; Urbanova, V.; Vidova, E. (Technical Univ., Prague). Radiochim. Acta; 17: No. 4, 209-212(Nov 1972).

The state of carrier-free ^{32}P (as phosphate) in aqueous solutions was studied by the method of dialysis, centrifugation, and electromigration. It is concluded that pseudocolloid particles of phosphorus are formed in the p_H region 2 to 9.5 due to the adsorption of hydrophosphate ions on fortuitous colloidal impurities in the solution. The pseudocolloids are neutral or negatively charged and their percentage increases with the age of the solution, but decreases when an indifferent electrolyte (NaCl) is added. In the solutions having the p_H value lower than 1.5 or higher than 9.5, the molecular or anionic forms of pentavalent phosphorus prevail, respectively. (auth)

19697 INVESTIGATION OF COMPLEX FORMATION WITH DIETHYLENETRIAMINEPENTAACETIC ACID. V. Plutonium (IV). Piskunov, E. M.; Rykov, A. G. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 345-346(1972).

Translated from Radiokhimiya; 14: No. 2, 332-333(1972).

The stability constant for diethylenetriaminepentaacetic acid (DTPA) complex with plutonium(IV) obtained by direct pH–potentiometric titration is $\lg\beta_{PuA^-}$ 29.49 ± 0.10. (DHM)

19698 KINETICS OF THE OXIDATION OF MULTIPLY CHARGED IONS. Vyatkin, V. E.; Davydov, Yu. P.; Shashukov, E. A. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 299-303 (1972).

Translated from Radiokhimiya; 14: No. 2, 289-293(1972).

It was shown that in the oxidation of Pu(IV) (10^{-6} to 10^{-5} g-atom/liter) by ozone in solutions 0.2 to 1.0 M HNO_3 at an ionic strength equal to 1.0, the reaction rate is described by the equation $-d[Pu(IV)]/dt = K\,[Pu(IV)]\,[O_3]^0/[H^+]$. The reaction rate constant K at 20°C is equal to $(1.32 \pm 0.13) \times 10^{-2}$ mole · liter^{-1} · min^{-1}, while the activation energy is 4.6 ± 1.2 kcal/mole. (auth)

19699 POLYMORPHISM OF THORIUM TUNGSTATE. Pokrovskii, A. N.; Rybakov, V. K.; Trunov, V. K. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 294-298(1972).

Translated from Radiokhimiya; 14: No. 2, 284-288(1972).

The existence of two new polymorphic modifications was established for thorium tungstate: β-$Th(WO_2)_2$ and α-$Th(WO_4)_2$. The parameters of the hexagonal unit cell of α-$Th(WO_4)_2$ were determined. In the region of 98 to 60 mole % $Th(WO_4)_2$ at 1000°C the existence of a solid solution of $Th_{1-x}Y_{4x/3} \cdot (WO_4)_2$ based on α-$Th(WO_4)_2$ was detected. The parameters of the unit cell were determined for various compositions. In the region of 80 to 60 mole % $Th(WO_4)_2$ at temperatures above 1200°C a cubic phase of variable composition $Th_xY_yWO_4$ is formed. The parameters of the unit cell were determined as a function of the composition. The T versus x diagram was constructed for the system $Th(WO_4)_2$–$Y_2(WO_4)_3$. (auth)

19700 INVESTIGATION OF THE COMPLEX FORMATION OF THE TRIVALENT ACTINIDE AND LANTHANIDE ELEMENTS BY THE METHOD OF ELECTROMIGRATION. XVII. Hydrolysis. Shalinets, A. B.; Stepanov, A. V. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 290-293(1972).

Translated from Radiokhimiya; 14: No. 2, 280-283(1972).

The hydrolysis of trivalent rare earth and transplutonium elements was studied by the method of electromigration at μ = 0.005, t = 25°C, and a total metal concentration of 10^{-5} M. In the range of pH from 2 to 5, the complex ions $[MOH]^{2+}$ and $[M(OH)_2]^+$ were identified and their stability constants calculated. (auth)

19701 INVESTIGATION OF THE COMPLEX FORMATION OF TRIVALENT ACTINIDE AND LANTHANIDE ELEMENTS BY THE METHOD OF ELECTROMIGRATION. XVI. Ethylenediaminetetraacetic Acid. Shalinets, A. B.; Sov. Radiochem. (Engl. Transl.); 14: No. 2, 285-289.

Translated from Radiokhimiya; 14: No. 2, 275-279(1972).

The complex formation of Am(III), Cm(III), and Ce(III) with EDTA was investigated by the method of electromigration in a medium of a porous filler at μ = 0.1 and t = 25 ± 0.1°C. The complex ions $M(HA)^0$, MA^-, and $MA(OH)^{2-}$ were identified and their stability constants determined. (auth)

19702 INVESTIGATION OF THE PURIFICATION OF BLACK BISMUTH FROM POLONIUM. Kirgintsev, A. N.; Koslyakov, V. I.; Prokhorov, L. A.; Aloi, A. S.; Selivanov, I. M. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 307-312(1972).

Translated from Radiokhimiya; 14: No. 2, 296-302(1972).

It was shown that the α activity of the bismuth obtained in the refinement of tin is due to an admixture of the polonium isotope ^{210}Po. The polonium concentration in bismuth, equal to 10^{-13}% by weight, was determined. Bismuth was purified from polonium by repeated direct crystallization and zone melting. It was shown that both methods can be used for the purification of bismuth from polnium to the background activity. (auth)

19703 INVESTIGATION OF THE COMPLEX FORMATION WITH DIETHYLENETRIAMINEPENTAACETIC ACID. IV. Neptunium(IV). Piskunov, E. M.; Rykov, A. G. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 342-344(1972).

Translated from Radiokhimiya; 14: No. 2, 330-332(1972).

The stability constant for diethylenetriaminepentaacetic acid (DTPA) complex with neptunium(IV) obtained by direct pH–potentiometric titration is $\lg\beta_{NpA}$ = 29.29 ± 0.2. (DHM)

19704 INVESTIGATION OF THE COMPLEX FORMATION WITH DIETHYLENETRIAMINEPENTAACETIC ACID. III. Uranium(IV). Piskunov, E. M.; Rykov, A. G. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 275-278(1972).

Translated from Radiokhimiya; 14: No. 2, 265-268(1972).

It was established that at an equimolar ratio of concentrations of U(IV) and DTPA in the solutions, a complex with the composition UA^- is formed. Its stability constant, determined by the method of pH–potentiometry, is $\lg\beta_{UA^-}$ = 28.76 ± 0.09 (μ = 0.5 t = 20°C). The ratio of stability constants of complexes of DTPA with Th(IV) and U(IV), determined by a spectrophotometric method, is $\beta_{ThA^-}/\beta_{UA^-} = 7.35 \times 10^{-3}$, which agrees with the result of pH–potentiometric measurements. (auth)

19705 INVESTIGATION OF THE COMPLEX FORMATION WITH DIETHYLENETRIAMINEPENTAACETIC ACID. II. Thorium(IV). Piskunov, E. M.; Rykov, A. G. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 270-274(1972).

Translated from Radiokhimiya; 14: No. 2, 260-265(1972).

The first acid dissociation constant of protonated diethylenetriaminepentaacetic acid $K_9 = (1.84 \pm 0.11) \times 10^{-2}$ was determined by the method of pH–potentiometric titration. It was established that an equimolar ratio of the concentrations of the metal and DTPA, the complex with the composition ThA^- is formed. The stability constants of the complex: $\log\beta_{ThA^-}$ = 26.64 ± 0.03 was determined by the method of pH–potentiometric titration. The stability constant of the complex of thorium with ethylenediaminetetraacetic acid with the composition ThA is $\log\beta_{ThA}$ = 21.84 ± 0.04. (auth)

19706 MECHANISM OF THE SORPTION OF PROTACTINIUM BY SILICA GEL. Spitsyn, V. I.; D'yachkova, R. A.; Kamenskaya, A. N. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 230-236(1972).

Translated from Radiokhimiya; 14: No. 2, 220-227(1972).

The mechanism of the sorption of protactinium by silica gel from solutions of nitric and perchloric acids in the region of concentrations 0.01 to 8 M was investigated. At $[H^+] < 1$ M, silica gel sorbs primarily cationic forms to an ion exchange mechanism with the displacement of hydrogen ions into the solution and the formation of a strong bond of protactinium with the oxygen atoms of the silanol groups. In the region of acidity above 1 M, cationic forms of the element are sorbed; sorption of neutral complexes of protactinium is also possible. The kinetics of the sorption of protactinium by silica gel is of an internal diffusion nature in the entire investigated acidity range. The rate of establishment of sorption equilibrium depends on the hydrogen ion concentration, passing through a minimum in the region of $[H^+]$ = 0.5 to 1.5 M. (auth)

19707 SOME PECULIARITIES OF THE PROPERTIES OF HYDROLYZED FORMS OF PLUTONIUM(IV). Davydov, Yu. P. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 225-229(1972).

Translated from Radiokhimiya; 14: No. 2, 216-220(1972).

It was shown that the transition of monomer hydrolyzed ions $Pu(OH)_n^{4-n}$ to the hydrated form of Pu^{4+} in a solution of 0.2 N HNO_3 occurs within several days, although, according to the ratio $K_{eq} = K_1/K_2$, this transition should occur very rapidly. (auth)

19708 SORPTION OF HYDROLYZED FORMS OF Pu(IV) BY SILICA GEL. Davydov, Yu. P. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 220-224(1972).

Translated from Radiokhimiya; 14: No. 2, 210-215(1972).

The sorption of Pu(IV) by silica gel was investigated in the range 0.5 M HNO_3 to pH = 2.5. It was shown that in the region of hydrolysis of Pu(IV), hydrolyzed ions $Pu(OH)_n^{4-n}$ are sorbed, and their sorption capacity is either equal to or greater than the sorption capacity of Pu^{4+} ions. It was shown that the sorption of hydrolyzed Pu(IV) ions does not depend on the concentration of the extraneous electrolyte in the range 0.1 M to 3.0 M $NaNO_3$. (auth)

19709 USE OF ION EXCHANGE TO DETERMINE THE CONDITIONS AND DEGREE OF POLYMERIZATION OF IONS IN SOLUTION. Davydov, Yu. P. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 215-219(1972).

Translated from Radiokhimiya; 14: No. 2, 206-210(1972).

An equation is proposed for determining the degree of polymerization of ions by the ion exchange method. The equation derived was used to determine the conditions and degree of polymerization of Pu(IV) and Zr(IV). (auth)

19710 SORPTION Pu(IV) BY ION EXCHANGE RESINS IN THE REGION OF HYDROLYSIS OF PLUTONIUM(IV). Davydov, Yu. P.; Bogatyreva, I. G. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 209-214(1972).

Translated from Radiokhimiya; 14: No. 2, 200-206(1972).

In an investigation of the sorption of Pu(IV) by the ion exchange resins KU-2, AV-17, and Dowex-1 in a broad range of acidity and plutonium concentrations in solution, it was shown that hydrolyzed monomer Pu(IV) ions show no specific sorption behavior with respect to ion exchange resins. It was established that polynuclear complexes of Pu(IV) show lower sorption capacity than monomer Pu(IV) ions. (auth)

19711 INTERACTION OF DIVALENT CATIONS WITH THORIUM OXALATE. Bykhovskii, D. N.; Petrova, I. K.; Zelentsov, S. S. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 180-185(1972).

Translated from Radiokhimiya; 14: No. 2, 171-177(1972).

The influence of divalent cations on the coprecipitation of small quantities of calcium with thorium oxylate was studied. The cations tested can be arranged in the following series with respect to the degree of such influence: $Pb^{2+} > Ca^{2+} \cong Sr^{2+} > Ba^{2+}$ $Cd^{2+} > Mn^{2+}$; Fe^{2+} and Ni^{2+} ions generally did not influence the coprecipitation of calcium. The composition of the precipitates crystallizing from oxalic acid solutions supersaturated with respect to thorium oxalate and containing various amounts of Ba, Ca, Cd, and Mn was studied. The compounds, $Ba_2Th(C_2O_4)_4 \cdot 11\ H_2O$ and $Mn_2Th_3(C_2O_4)_8 \cdot 18\ H_2O$ were isolated; a solid phase with the composition $Cd_{0.7}Th(C_2O_4)_{2.7} \cdot 6\ H_2O$, possessing substantial similarity to the manganese compound, was obtained. The region of existence of a solid solution was also found in the system $Mn(II)-Th(C_2O_4)_2$; evidently, such regions also exist in systems including Cd and Ba. (DHM)

19712 DETERMINATION OF THE THERMODYNAMIC EQUILIBRIUM CONSTANT OF THE OXIDATION OF PENTAVALENT NEPTUNIUM BY NITRIC ACID. Shilin, I. V.; Nazarov, V. K. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 304-306(1972).

Translated from Radiokhimiya; 14: No. 2, 293-296(1972).

The thermodynamic equilibrium constant for the reaction $NpO_2^+ + 3/2\ H^+ + 1/2\ NO_3^- \xrightleftharpoons{K_{eq}} NpO_2^{2+} + 1/2\ H_2NO_2 + 1/2\ H_2O$ was calculated. Its value at 40°C is equal to 3.37×10^{-4}. The influence of the temperature on the value of the equilibrium constant was investigated in the interval 10 to 50°C. The thermal effect of the reaction is equal to 4500 ± 50 cal/mole. (auth)

19713 MEASUREMENTS OF CHEMICAL DIFFUSION COEFFICIENTS IN NONSTOICHIOMETRIC OXIDES USING SOLID-STATE ELECTROCHEMICAL TECHNIQUES. Steele, B. C. H.; Riccardi, C. C. (Imperial Coll. of Science and Tech., London). pp 123-135 of Metallurgical Chemistry. Kubaschewski, O. (ed.). London; Her Majesty's Stationery Office (1972).

From International symposium on metallurgical chemistry; London, UK (14 Jul 1971). See CONF-710738-.

An electrochemical technique was derived that enables oxygen chemical diffusion coefficients to be determined in nonstoichiometric oxides at various compositions and temperatures. The method appears to be at least as accurate as the usual gaseous oxidation/reduction procedures. The measurements can be made over much narrower ranges of composition, and it has been shown that the chemical diffusion coefficient is concentration-dependent in CeO_{2-x}, and also in UO_{2+x}. Whereas the self-diffusion coefficients are directly proportional to the defect concentration, the chemical diffusion coefficients appear to be inversely proportional to the defect concentration. Theoretical equations relating self-diffusion and chemical-diffusion coefficients seem to make it possible to predict approximately the chemical diffusion coefficient for small deviations from stoichiometry. The results also suggest that the interfacial mass transport processes can significantly affect the output of the cell. This effect is more marked at lower temperatures and when the nonstoichiometric oxide is subject to anodic conditions. The present investigation was concerned with measurements of the chemical diffusion coefficients of oxygen but, in principle, a similar electrochemical technique can be used to study the chemical diffusion of any species provided that a suitable solid electrolyte is available. (auth)

19714 CHLORINATION OF METAL OXIDES. Knacke, O. (Technische Hochschule, Aachen). pp 549-558 of Metallurgical Chemistry. Kubaschewski, O. (ed.). London; Her Majesty's Stationery Office (1972).

From International symposium on metallurgical chemistry; London, UK (14 Jul 1971). See CONF-710738-.

The volatilization of metal oxides with gaseous chlorine reactants, namely elemental chlorine, hydrochloric acid, or phosgene is explored using U–O–Cl and Ti–O–Cl systems as examples. Equilibrium diagrams of U–O–Cl at 450°C and Ti–O–Cl at 394°C are given. The chlorination of oxide particles embedded in an inert matrix is also considered. (DHM)

19715 ELECTROPHORETIC AND CHROMATOGRAPHIC SEPARATION OF IODIDE, IODATE, TELLURITE, AND TELLURATE. Zmbova, B.; Jovanovic, V.; Bzenic, J. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Isotopenpraxis; 8: No. 8, 295-297(Aug 1972).

Two procedures for the separation of iodine and tellurium anions are described. Electrophoresis and paper chromatography were used to study the radiochemical purity of carrier-free Na ^{131}I solution. (auth)

19716 ABSORPTION SPECTRUM AND REACTION KINETICS OF THE PHOTOREACTIVE STATE OF THE URANYL ION. Allen, D. M.; Burrows, H. D.; Cox, A.; (and others) (Warwick Univ., Coventry, Eng.). J. Chem. Soc., Chem. Commun.; No. 2, 59-60 (17 Jan 1973).

Excitation (μs and ns) of aqueous solutions of uranyl salts produces a short-lived absorption ($t_{\frac{1}{2}} \sim 1.05\ \mu s$), which is systematically quenched on addition of a variety of organic substrates known to protoreduce the UO_2^{2+} ion. The isotope effect of 2.76 obtained with CH_3OH and CD_3OH exactly matches that found for quenching of the fluorescence of UO_2^{2+} by these substrates. Absolute rate constants were determined for some photoreactions of UO_2^{2+} for the first time. (auth)

19717 SELF-DIFFUSION OF $^{91}Y(3)$ IN AQUEOUS SOLUTIONS. Its Interaction with Fe(3) and Sr(2) at High Dilution. Kepak, F. (Ustav Jaderneho Vyzkumu, Rez, Czech.). J. Inorg. Nucl. Chem.; 35: No. 1, 145-152(Jan 1973).

The dependence of the self-diffusion coefficient of $^{91}Y(III)$ at 10^{-3}M and 10^{-6}M concentrations on pH was determined and the effect of the presence of 10^{-6}M Fe(III) on the self-diffusion of 10^{-3}M Y(III) and of the presence of 10^{-3}M and 10^{-6}M Y(III) on the self-diffusion of 10^{-3}M Sr(II) was studied. The slowed down self-diffusion of Y(III) indicates the gradual formation of agglomerates of Y(III) hydroxide molecules. The possibility of coprecipitation of Y(III) with Fe(III) hydroxide and adsorption of Sr(II) on Y(III) hydroxide has been inferred from the course of the self-diffusion of Y(III) in the presence of Fe(III) and of Sr(II) in the presence of Y(III). (auth)

19718 THERMAL DESORPTION STUDY OF THE SURFACE INTERACTIONS BETWEEN WATER AND PLUTONIUM DIOXIDE. Stakebake, J. L. (Dow Chemical, Golden, CO). J. Phys. Chem.; 77: No. 5, 581-586(1 Mar 1973).

The interactions between water vapor and plutonium dioxide were investigated using a mass spectrometric thermal desorption technique. Chemisorbed water vapor was found to be desorbed in two temperature ranges: one between 100 and 150°C and the second between 300 and 350°C. In terms of adsorption, these results are attributed to the hydroxylation of the oxide followed by the double hydrogen bonding of water molecules to the hydroxyl groups.

The heat of adsorption was calculated to be 68 kcal/mol for hydroxylation and 20 kcal/mol for the hydrogen bonding. (auth)

19719 SELF-DIFFUSION OF OXYGEN IN $^{238}PuO_2$. Deaton, R. L.; Wiedenheft, C. J. (Monsanto Research Corp., Miamisburg, OH). J. Inorg. Nucl. Chem.; 35: No. 2, 649-650(Feb 1973).

The self-diffusion coefficient of oxygen in PuO_2 was determined from the gas-solid isotope exchange between $^{238}PuO_2$ microspheres and ^{18}O. Solutions to the diffusion equation for measurements of this type were developed by Carman and Haul (1954) and by Crank (1956). From the results it was calculated that the activation energy for the self-diffusion of oxygen in PuO_2 is 42.2 kcal/mole. This compares favorably with 29.7 kcal/mole for UO_2 and 56.0 kcal/mole for ZrO_2, all of which are oxides which have the fluorite structure. (auth)

19720 PLUTONIUM POLYMERIZATION. 3. The Nitrate Precipitation of Pu(IV) Polymer. Bell. J. T.; Coleman, C. F.; Costanzo, D. A.; Biggers, R. E. (Oak Ridge National Lab.,TN). J. Inorg. Nucl. Chem., 35: No. 2, 629-632(Feb 1973).

The precipitation of aged Pu(IV) polymer by HNO_3, $LiNO_3$, $Al(NO_3)_3$, and $NaNO_3$ was observed. With the exception of $LiNO_3$, the precipitation of 0.00678M Pu(IV) polymer was independent of the source of NO_3^-, and the maximum amount of precipitated polymer occurred at 1.8 NO_3^-. Further addition of NO_3^- redissolved the polymer. The nitrate precipitation of Pu(IV) polymer was analyzed according to the solubility product principle and was found to closely resemble a solubility product mechanism. (auth)

19721 PLUTONIUM POLYMERIZATION. 1. A Spectrophotometric Study of the Polymerization of Plutonium(IV). Costanzo, D. A.; Biggers, R. E.; Bell, J. T. (Oak Ridge National Lab., TN). J. Inorg. Nucl. Chem., 35: No. 2, 609-622(Feb 1973).

Standard spectra of the Pu species were observed and then used in the calculations of the distribution of Pu(III), (IV), (V), (VI), and polymeric Pu(IV) in solutions containing ~ 0.009M total Pu at initial acidities of 0.1, 0.075, 0.06, and 0.04M HNO_3, and at 25, 50, and 75°C. The distributions of the Pu species are given for the four acidities at 25°C, and the distributions are given for the initial acidity of 0.075M HNO_3, at 25, 50, and 75°C. In these studies the polymer is not formed when the initial acidity is 0.1M and the temperature is 25°C, but the degree of polymerization continuously increases at the lower acidities and is almost quantitative when the initial acidity is 0.04M. The effect of an increasing temperature is to increase the rate of polymerization at the expense of the ionic Pu species. The amount of polymer formed at 75°C is ~ 3.5 times as great as the amount at 25°C when the initial acidity is 0.075M. (auth)

19722 PLUTONIUM POLYMERIZATION. 2. Kinetics of the Plutonium Polymerization. Bell. J. T.; Costanzo, D. A.; Biggers, R. E. (Oak Ridge National Lab., TN). J. Inorg. Nucl. Chem.; 35: No. 2, 623-628(Feb 1973).

Experimental data for the distribution of Pu(III), Pu(IV), Pu(V), Pu(VI), and Pu(IV) polymer were used to calculate the rates of polymerization of Pu(IV). The rate of formation of Pu(IV) polymer is proportional to the first power of the Pu(IV) concentration and to the inverse square of the acidity as long as the solution contains a detectable amount of Pu(IV). When the concentration of Pu(IV) is not detectable, the rate of polymerization is proportional to the product of the square roots of the Pu(V) and (III) concentrations. When the concentrations of both the Pu(IV) and (III) are not desirable, the rate of polymerization is proportional to the product of the squares of the Pu(V) and the acid concentrations and to the inverse first power of the Pu(VI) concentration. (auth)

19723 URANYL NITRATE AND THIOCYANATE COMPLEXES WITH SOME PYRIDINE N-OXIDES. Ahuja, I. S.; Signh, R. (Banaras Hindu Univ., India). J. Inorg. Nucl. Chem.; 35: No. 2, 561-566(Feb 1973).

The complexes formed by uranyl nitrate and thiocyanate with pyridine N-oxide, 2-methyl-, 3-methyl-, 4-methyl-, 2, 6-dimethyl-, and 4-cyanopyridine N-oxides were prepared. These complexes were examined spectroscopically (down to 200 cm^{-1}) in the solid state and the possible coordination arrangement around the metal atoms discussed. (auth)

19724 PREPARATION AND CRYSTAL STRUCTURES OF AMERICIUM DICHLORIDE AND DIBROMIDE. Baybarz, R. D. (Oak Ridge National Lab., TN). J. Inorg. Nucl. Chem.; 35: No. 2, 483-487(Feb 1973).

The preparation and identification of two divalent americium compounds, AmCl2 and $AmBr_2$, are reported. Lattice constants for the orthorhombic $AmCl_2$ are $a_0 = 8.963 \pm 0.008$, $b = 7.573 \pm 0.008$, and $c = 4.532 \pm 0.006$ Å. The lattice constants for the tetragonal $AmBr_2$ are $a_0 = 11.592 \pm 0.004$ and $c = 7.121 \pm 0.003$ Å. (auth)

Radioactive Waste Treatment

Refer also to abstract 21860.

19725 (HEDL-SA-236) SOLIDIFICATION OF HIGH-LEVEL LIQUID RADIOACTIVE WASTES. Blasewitz, A. G.; McElroy, J. L.; Schneider, K. J. (Hanford Engineering Development Lab., Richland, Wash.). Jun 1971. Contract AT(45-1)-1830. 18p. (CONF-710710-13). Dep. NTIS.

From 16th Annual Health Physics Society Meeting; New York, New York, United States of America (USA) (12 Jul 1971).

Four basic solidification processes, spray solidification, pot calcination, phosphate glass solidification, and fluidized bed calcination, are currently being demonstrated on an engineering-scale with radioactive wastes. The spray, pot, and phosphate glass solidification processes have been demonstrated on highly radioactive aqueous wastes at rates of 20 liters/hr in the AEC's Waste Solidification Engineering Prototypes (WSEP) at Hanford during the period of November 1966 thru October 1970. The fluidized bed calcination process has been demonstrated at high rates of 300 liters/hr of moderately radioactive aqueous waste at AEC's Waste Calcination Demonstration plant (WCD) by Idaho Nuclear Corporation since December 1963. The processes have been quite thoroughly developed and are ready for commercial application. An extensive program has been established and is well underway at Hanford to measure and evaluate the characteristics of the solidified products. (auth)

19726 (HW-19170) TBP PLANT SOLVENT-EXTRACTION PULSE COLUMNS. Solvent-Extraction Studies Leading to the Development of Pulse Column Specifications for the TBP Waste Metal Recovery Plant. Stevenson, R. L.; Bradley, J. G. (General Electric Co., Richland, Wash.). 6 Nov 1951. Contract W-31-109-eng-52. 93p. Dep. NTIS.

Declassified 31 Jan 1973.

19727 PROCESS FOR PREPARING AND CONDITIONING OF SPECIFIC ADSORBENTS FOR RADIOACTIVE AND INDUSTRIAL EFFLUENTS. Godar, S. Belgian Patent 780,688. 15 Sep 1972. (In French).

The purpose of the invention is to decrease the price and the inconveniences in conditioning specific adsorbents. An aqueous solution, containing the adsorbent, resulting from the mixture of reactants in aqueous solution, is poured into a composite (of plaster or cement), of a nature such that it is taken up completely without the specific adsorption properties of the final product being appreciably altered. The advantages of the product obtained are given. (tr-auth)

19728 SORPTION OF BORIC ACID BY ANION EXCHANGE RESINS FROM SOLUTIONS SIMULATING LOOP WATER IN NUCLEAR REACTORS, AND CONDITIONS FOR ITS DESORPTION. Rauzen, F. V.; Shakhov, E. A. At. Energy. (USSR); 33: No. 4, 850-1(Oct 1972). (In Russian).

A comparison of the total exchange capacity for borate ion of five anion exchangers showed a wide range of capacities from 45 to 130 (arbitrary scale) based on a stock solution representing reactor loop water and having the following composition: 5 to 6 mg KOH/liter, 40 mg NH_4OH/liter, 2 to 3 g H_3BO_3/liter, pH = 8. Desorption efficiency of the borate ion from the resins was attempted with KOH solutions ranging from 0.1 to 1 N, and contrasted with that of H_2O and NH_4OH. The KOH solutions were most effective for desorption, and the 1 N KOH was superior to KOH solutions of lesser concentrations. (KSW)

19729 REMOVAL OF RADON FROM AIR BY OXIDATION WITH BROMINE TRIFLUORIDE. Stein, L. (Argonne National Lab., Il). J. Inorg. Nucl. Chem.; 35: No. 1, 39-43(Jan 1973).

An oxidation method for removing radon from air with liquid bromine trifluoride was tested with samples of ambient air containing 0.098 to 0.189 pCi/l of ^{222}Rn. Ninety-five percent of the radon was removed in a two-stage gas-scrubbing unit (20 ml liquid volume) at a flow rate of 130 ml/min, and smaller percentages were removed at higher flow rates (minimum of 76% at 640 ml/min). The possibility of purifying air in uranium mines with bromine trifluoride and other oxidants is discussed. (auth)

19730 PROCEDURE FOR THE RECOVERY OF PLUTONIUM FROM FABRICATION RESIDUES OF MIXED URANIUM–PLUTONIUM OXIDE FUELS. Heremans, R. H.; Vandersteene, J. J. (to Centre d'Etude de l'Energie Nucleaire). Belgian Patent 785,836. 31 Jul 1972. 13p. (In French).

A process is described for recovery of plutonium from wastes from the fabrication of fuels of mixed oxides of uranium and plutonium in the form of PuO_2. The residues are converted to fluorides, and the UF_6 and PuF_6 obtained are separated by selective absorption of the PuF_6 on NaF at a temperature of at least 400°C. The complex obtained by this absorption is dissolved in nitric acid, the plutonium is precipitated in the form of plutonium oxalate by the addition of oxalic acid, and the precipitated plutonium oxalate is calcined. (tr-auth)

19731 ISOTHERM OF COAGULATION DEACTIVATION. I. Removal of a Radioelement on Account of Adsorption by a Precipitate of the Coagulant. Pavlov–Verevkin, B. S.; Sov. Radiochem. (Engl. Transl.); 14: No. 2, 202-208(1972).

Translated from Radiokhimiya; 14: No. 2, 193-200(1972).

The dependence of the residual activity on the initial activity in the coagulation deactivation of radioactive solutions, occurring on account of adsorption coprecipitation of radioactive elements with a precipitate of a metal hydroxide coagulant under constant conditions of coagulation (t, pH, amount of coagulant and extraneous salts) was expressed in explicit form and analyzed. It was shown that in the region of applicability of the equation of the Henry adsorption isotherm, the dependence of the residual activity on the initial activity at any dose of the coagulant can be calculated if the residual activity is known for any one dose of the coagulant. The functions derived permit a determination of the coefficient k of the Henry equation in the presence of microconcentrations of a radioactive element and both coefficients of the equation of the Langmuir isotherm in the study of coagulation deactivation within broad limits of variation of the concentration of the radioactive element. The equations obtained for the isotherm of coagulation deactivation have an advantage over the isotherms of adsorption usually used, in that they give the relationship between quantities directly measurable during the deactivation of water: the initial and residual radioactivity of the solution. (auth)

19732 CONCERNING THE ARTICLE OF V. L. ZOLOTAVIN, ET AL., DEACTIVATION OF SEWAGE BY TWO-STAGE COAGULATION OF FERRIC HYDROXIDE. Pavlov–Verevkin, B. S. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 347-348(1972).

Translated from Radiokhimiya; 14: No. 2, 333-334(1972).

The explanation by the authors [V. L. Zolotavin, et al., Radiokhimiya, 13, No. 1, 164(1971)] of the factors leading to an increase in deactivation during repeated coagulation in the deactivation of sewage by coagulation of ferric hydroxide is questioned. (DHM)

19733 ISOTHERM OF COAGULATION DEACTIVATION. II. Formation of an Independent Solid Phase of a Sparingly Soluble Compound of a Radioelement. Pavlov–Verevkin, B. S. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 339-341(1972).

Translated from Radiokhimiya; 14: No. 2, 328-330(1972).

It was shown that above a definite initial activity of the solutions, the isotherm of coagulation deactivation in the case of formation of an intrinsic solid phase of radioelements is a straight line parallel to the X-axis, and the residual activity of the solutions does not depend on a further increase in the initial activity. In this region the residual activity cannot be lowered below that corresponding to the solubility product of the sparingly soluble compound of the radioelement by a single coagulation deactivation. (auth)

19734 USE OF NATURAL ADSORBENTS FOR THE PURIFICATION OF RADIOACTIVE WATER. Sachse, G.; Mittag, I. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Isotopenpraxis; 8: No. 7, 267-273(Jul 1972). (In German).

A great number of naturally occuring material, such as silica peats and lignites, show genuine ion exchange properties. The merits of natural adsorbents are their low cost, frequent existence of selectivity, and the possibility of fixing the radionuclides by means of a burning process in the inorganic adsorbent, or ashing the organic adsorbent. Their disadvantages are low grain stability, tendency towards the formation of colloidal suspensions, and the very low absorptivity for anionic radionuclides. Vast investigations carried out with raw material showed that especially bentonites and peats possess favorable properties. An estimate made to find out the range of their use showed that natural adsorbents would be suitable for sewage in case of accidents. Under the conditions of operation and waste removal existing in the GDR, routine waste water decontamination is best accomplished by using synthetic organic ion exchange resins. (auth)

19735 ATTEMPT AT APPLYING THE BOX AND WILSON METHOD IN THE RADIOCHEMICAL PRACTICE. Todorovski, D.; Nikolov, N. (Univ., Sofia). Isotopenpraxis; 8: No. 8, 314-315 (Aug 1972).

Application of the Box and Wilson method for finding out optimal conditions to reach maximum chemical yield in radiochemical procedure for isolation of radioiodine out of the cooling water of a nuclear reactor is described. Finding out the conditions of the extremum (yield 92%) is obtained by a minimum number of experiments and application of uncomplicated mathematic methods. (auth)

19736 MECHANISM OF LEACHING ^{137}Cs, ^{90}Sr, AND ^{60}Co FROM SOLIDIFIED CEMENT. Terasima, Y. (Kanazawa Univ., Japan); Aoyama, I.; Iwai, S.; Inoue, Y. Doboku Gakkai Ronbun Hokohushu; No. 201, 51-60(May 1972). (In Japanese).

Investigation of the mechanism of leaching of radioactive materials solidified in cement was performed. Radioactive nuclei used for the study were ^{90}Sr, ^{137}Cs, and ^{60}Co. The radioactive materials were dissolved in water, and the pH of the solution was adjusted with HCl. The radioactive solution was mixed with cement and solidified. The influence of flow rate and shaking on the leaching of the activity from the cement paste was observed. Appreciable influence could not be seen. The leaching of activity into tap water and seawater for a period of about one year was investigated. Variation was observed on the surface of the solidified bodies in the seawater. The leaching of ^{137}Cs depended on the ratio of water to cement in the solidified bodies, as well as the leaching of ^{90}Sr. Rate of the leaching of ^{60}Co was slow. It was concluded that the leaching of ^{137}Cs and ^{90}Sr is due to diffusion in the gap of cement paste, while that of ^{60}Co is not. (auth)

Radioisotope Production

Refer also to abstract 21870.

19737 (BLG-467, pp 5.1-5) PRODUCTION AND APPLICATION OF RADIOISOTOPES.

MOLECULES—separation of free, from antigen–antibody complexes in radioimmunoassay, comparison of methods for, p. 3
RADIOIMMUNOASSAY—free molecule separation from antigen–antibody complexes in, comparison of methods for, p. 3
RADIOISOTOPES—production of, research progress on, pp. 1-4
TECHNETIUM-99—production of isomeric, liquid–liquid extraction apparatus for (DHM)

19738 (BLG-467, pp 6.1-9) ACTINIUM PROGRAMME.

ACTINIUM—separation from thorium by chromatographic ion exchange, p. 5
—purification by chromatographic ion exchange, p. 5
ACTINIUM-225—production by beta decay of radium-225 from neutron reaction (n,2n) with radium-226, radiochemical studies of, p. 5
ACTINIUM-227—production from neutron irradiation of radium-227, research progress on, pp. 1-9
ACTINIUM OXIDES—immobilization of powders of, used as isotopic heat source, pp. 6-9
—metallurgical properties of, pp. 6-9
ALPHA SOURCES—fuel conditioning for Ac_2O_3, pp. 6-9
—venting plugs of, pp. 6-9
THORIUM—separation of actinium by chromatographic ion exchange, p. 5
THORIUM-228—production from neutron irradiation of radium-227, research progress on, pp. 1-9 (DHM)

19739 (CONF-730107-1) REACTOR PRODUCTION OF RADIOISOTOPES. Rupp, A. F. (Oak Ridge National Lab., Tenn.). 13 Jan 1973. 12p. Dep. NTIS.

The reactor production of radioisotopes is relatively easy and very large quantities of a wide spectrum of radioisotopes can be made. Variations in reactor irradiation procedures and equipment are found for the various kinds of reactors and the kind of handling and process equipment used for the irradiated target. The two main improvement goals for reactor radioisotope production are higher flux and wider neutron energy spectrum. A very important group of reactor products are those produced in the fission process. These include both long-lived and short-lived radioisotopes. In the selection of targets, enriched targets should be considered when the abundance of the target atom in an element is less than 50%, particularly in those cases where the valuable target material can be reclaimed and used. Radioisotopes that do not occur in natural elements and certain stable isotopes can be gotten by nuclear transformation processes and are of great value as target materials. (ERB)

19740 (JINR-P12-6661) VAPORIZATION OF NUCLEAR REACTION PRODUCTS FROM IRRADIATED URANIUM OXIDES BY OXIDATION AND REDUCTION REACTIONS. Aikhler, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear

Reactions). 1972. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

The vaporization of the carrier free elements Cd, In, Sn, Te, I, Xe, Hg, Tl, Pb, Po, At, and Rn from uranium oxides that was irradiated by protons in the process of cyclic phase transformation in the stoichiometric region $UO_{2.00}$ ... $UO_{2.67}$ was investigated. The optimum parameters of the process were determined. The mentioned elements were selectively separated from actinides. Conclusions are made with reference to the behavior of hypothetical superheavy elements Z = 112 ... 118 in the separation. (tr-auth)

19741 (JINR-P12-6662) INVESTIGATION OF DISTRIBUTION OF A FEW CARRIER FREE NUCLEAR REACTION PRODUCTS IN A TEMPERATURE GRADIENT TUBE IN A HYDROGEN GAS STREAM. Aikhler, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1972. 22p. (In Russian). Dep. NTIS (U. S. Sales Only).

The elements Zn, Ga, Ge, As, Br, Cd, In, Sn, Sb, Te, I, Hg, Tl, Pb, Bi, Po, and At were separated in groups in quartz powder filled columns in a temperature gradient (1100 to 20°C). Conclusions are made with reference to the probable chemical states of the transported and separated components and to the probable behavior of the hypothetic superheavy elements Z = 112 to 118 in the thermochromatographic separation. (auth)

19742 PHARMACOLOGICAL PROBLEMS IN THE USE OF ISOTOPE COWS. Pal, I. (MTA Izotop Intezete, Budapest). Izotoptechnika; 16: No. 1, 37-45(Jan 1973). (In Hungarian).

The advantages of short-lived nuclides, construction of the cows, various types of cows, and pharmaceutical compounds incorporating the daughter compounds are discussed. (auth)

19743 REVERSED-PHASE FOAM CHROMATOGRAPHY. Separation of trace amounts of cobalt from nickel in the tri-n-octylamine–hydrochloric acid system. Braun, T. (Lorand Eoetvoes Univ., Budapest); Huszar, E.; Bakos, L. Anal. Chim. Acta; 64: No. 1, 77-84(Mar 1973).

The post-irradiation separation of ^{58}Co produced from ^{58}Ni activated in nickel metal or salts by irradiation with fast neutrons is an important radiochemical preparative method for the production of carrier-free ^{58}Co. The separation of cobalt and nickel in hydrochloric acid media by reversed-phase chromatography on open-cell polyether-type polyurethane foam columns loaded with tri-n-octylamine hydrochloride was studied. The results showed that good results are obtained with 11.4 and 17.7% loadings of the amine. The separation was studied in the Ni: Co range from 1 to 10^8. (auth)

19744 RADIOISOTOPE LABORATORY TECHNIQUES. Third Edition. Faires, R. A.; Parks, B. H. New York; John Wiley and Sons, Inc. (1973). 322p. $11.50.

The subject is discussed under the following headings: elements of nuclear physics; properties of radiations; production of radioisotopes; introduction to health physics; the laboratory; hazard control; decontamination and disposal of waste; laboratory apparatus; introduction to electronic techniques; detection devices, integrating types; particle detectors and their use; associated equipment; errors and corrections; the statistics of counting; the choice of counting equipment; special counting techniques; liquid scintillation counting; feasibility; radioactive techniques in analysis; autoradiography and gamma radiography; and applications of isotopes and radiation. (ERB)

19745 RADIOISOTOPE GENERATOR. Holgate, R. L.; Montgomery, J. R. (to Mallinckrodt Chemical Works). U. S. Patent 3,710,118. 9 Jan 1973. Filed date 25 May 1970. 10p.

A generator is provided for eluting a daughter radioisotope from a parent radioisotope. The generator is characterized by an elongate closed vessel having a convergent closed lower end and containing therein a supply of a parent radioisotope material spaced from the closed lower end. The vessel is closed at its upper end with a closure through which extends a first conduit communicating with the upper end of the vessel for introducing an eluant into the vessel. Also extending through the closure is a second conduit communicating with the lower end of the vessel, which provides for passage of eluate from the lower end of the vessel. (Official Gazette)

19746 ION EXCHANGE SEPARATION OF ^{242}Cm FROM PLUTONIUM, AMERICIUM, AND FISSION PRODUCTS. Thompson, G. H. (E. I. du Pont de Nemours and Co., Aiken, SC). Ion Exch. Membranes; 1: No. 2, 87-89(Dec 1972).

Curium-242 was separated from plutonium by anion exchange and from americium and fission products by pressurized cation exchange in a high-flow system. Excellent anion exchange separation of Pu from 1 Ci/ml solutions can be obtained if radiolytically formed NO_2^- is eliminated prior to and during the valence adjustment of Pu. (JGB)

19747 CATION EXCHANGE ELUTION SEQUENCE WITH DTPA. Hale, W. H. Jr.; Hammer, C. A. (E. I. duPont de Nemours and Co., Aiken, SC). Ion Exch. Membranes; 1: No. 2, 81-85(Dec 1972).

The cation exchange elution sequence of 42 cations, including all of the lanthanides and 8 of the actinides, was determined with 0.05M diethylenetriaminepentaacetic acid {indexed as [(carboxymethylimino)bis(ethylenenitrilo)] tetraacetic acid} at pH 6.0. The data provided the basis for a process to purify several kilograms of ^{244}Cm and ^{243}Am and several milligrams of ^{252}Cf. Elution sequence could not be predicted accurately from available thermodynamic data. (auth)

19748 SORPTION OF PRASEODYMIUM BY CATION EXCHANGE RESIN FROM MIXTURES OF SODIUM NITRATE AND NITRIC ACID. Kelley, J. A.; Wallace, R. M.; Snow, R. L. (E. I. du Pont de Nemours and Co., Aiken, SC). Ion Exch. Membranes; 1: No. 1, 47-50(Aug 1972).

A method was developed, with $Pr(NO_3)_3$ as a stand-in for all lanthanides and actinides, for predicting the capacity of cation exchange resin for lanthanide (Ln) and actinide (An) sorption from solutions at various $NaNO_3$, HNO_3, and $Ln–An(NO_3)_3$ concentrations. A least squares fit of the sorption data to a simple equilibrium model gave excellent agreement between experimental data and the calculated curve. The incorporation of calculated activity coefficients for the aqueous phase into the equilibrium model only slightly improved the fit of experimental data to the theoretical curve. (auth)

19749 NEW METHOD OF ISOLATION OF ^{131}I FROM NEUTRON IRRADIATED TELLURIUM. Kozyreva, Aleksandrova, L. S.; Levin, V. I.; Ivanov, Yu. F.; Zalesskii, V. G.; Shubnyakova, L. P. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 320-325(1972).

Translated from Radiokhimiya; 14: No. 2, 308-314(1972).

The process of distillation of ^{131}I from solutions of neutron-irradiated tellurium dioxide in phosphoric acid was studied. It was established that the introduction of reducing agents during distillation does not lead to an increase in the yield of iodine in the distillate. On the contrary, if elementary tellurium is formed under the action of the reducing agent, there are substantial losses of iodine as a result of adsorption. The optimum conditions of the isolation of ^{131}I from neutron-irradiated tellurium dioxide by distillation from phosphoric acid were determined. Distillation must be conducted from concentrated acid (sp. gr. 1.84), maintaining the temperature at a level of 240 ± 10°c, and pumping a stream of air through the distillation flask. A solution of ^{131}I with a specific activity not lower than 50 mCi/ml and a yield of not less than 80 to 90% is obtained according to this method. Impurities of extraneous radioisotopes (Se and Te) do not exceed 10^{-2}%. The phosphorus impurity (in the form of phosphate) in the distillate does not exceed 0.25 mg/ml. The advantages of the method developed include simplicity (the process of isolation of iodine consists virtually of one operation), high yield, purity of the product, and possibility of obtaining solutions of ^{131}I with a high specific activity without additional concentration. (auth)

19750 BEHAVIOR OF A TRACE IMPURITY OF ^{22}Na IN THE PRECIPITATION OF MAGNESIUM SULFATE WITH ORGANIC SOLVENTS. Zhukovskaya, A. S.; Rudenko, N. P. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 186-191(1972).

Translated from Radiokhimiya; 14: No. 2, 178-183(1972).

A method is proposed for the isolation of ^{22}Na from a magnesium cyclotron target in which the basic amounts of the target element are separated with the aid of a standard, and the final purification of radioactive sodium from magnesium was accomplished by ion exchange on the cation resin KU-2. The method of precipitation of magnesium sulfate was used as an intermediate stage in the concentration of ^{22}Na. The process of formation of a magnesium sulfate precipitate under the action of ethanol or acetone was investigated. It was established experimentally that the magnesium sulfate precipitate isolated with the aid of organic solvents almost entirely entraps the trace impurity of ^{22}Na at the moment of its formation. Subsequently, during the maturation of the precipitate in contact with the mother liquor, the microcomponent passes back into the liquid phase. (DHM)

19751 ^{188}Re GENERATOR. Mikheev, N. B.; Popovich, V. B.; Rumer, I. A.; Savel'ev, G. I.; Volkova, N. L. (Inst. of Physical Chemistry, Moscow). Isotopenpraxis; 8: No. 7, 248-251(Jul 1972). (In Russian).

A method to prepare a rhenium-188 isotope generator making use of chromatographic alumina as an adsorbent for phosphorous tungstate containing tungsten-188 was developed. The sorption of

various tungsten compounds by alumina was explored: a normal tungstate, a para-tungstate, and a phosphotungstate. It was found that tungsten sorption efficiency by alumina increases by eight times when passing from normal tungstate to phosphotungstate, ranging to 0.215 g WO_3/1 g Al_2O_3 with regard to the latter. Elutriation of rhenium-188 is performed in the generator by means of a pH 3 sodium chloride isotonic solution. During elutriation about 70% of the total rhenium quantity is to be found in 4 ml of eluate. The radioisotope purity of the obtained product is not less that 99.9%. The generator withstands a minimum of 50 elutriation processes. (auth)

19752 PRODUCTION AND CLINICAL DEVELOPMENT OF A NEW IDEAL RADIOISOTOPE OF IODINE-^{123}I. Wellman, H. N.; Sodd, V. J.; Mack, J. F. (Cincinnati General Hospital). pp 19-30 of Frontiers of Nuclear Medicine. Horst, E. (ed.). New York; Springer-Verlag (1971).

Iodine-123 is an ideal isotope of iodine for thyroid imaging and function studies because of its significant dose reduction to the patient and optimum energy for scanning. However, pure ^{123}I is the only way to take full advantage of these characteristics since ^{124}I contamination obviates many of the advantages of ^{123}I. The indirect method of ^{123}I production from ^{123}X appears to be the only practical solution for obtaining "pure" ^{123}I. (auth)

19753 ACTIVATION OF ^{11}C BY BETATRON OR LINEAR ACCELERATOR AND ITS POTENTIAL BIOLOGICAL AND MEDICAL USES AS TRACER AND SCANNING SUBSTANCE. Moersdorf, D. (Czerny-Krankenhaus, Heidelberg); Wunder, S.; Schwall, H.; Behschad, H.; Schenk, P. pp 41-45 of Frontiers of Nuclear Medicine. Horst, W. (ed.). New York; Springer-Verlag (1971). (In German).

A potential biophysical tracer is described: ^{11}C, which has a half-life of 20.5 min with 0.5-MeV gamma radiation and can be employed with existing equipment and drugs in common use. Substances containing ^{12}C are activated by gamma rays of a threshold energy of at least 19 MeV, produced by betatron or linear accelerator. There is difficulty in incorporating sufficient tracer into a non-toxic quantity of a physiological substance. The work was supported by animal experiments and chemical analyses. (auth)

Reactor Fuel Reprocessing

Refer also to abstract 19554.

19754 (AECL-4143) FUEL REPROCESSING WITH TERTIARY AMINE EXTRACTANTS. Part 1. Analysis of the process solvent. Dyck, R. W.; Taylor, R.; Daun, J. K.; Boase, D. G. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). Oct 1972. 25p. Dep. NTIS (U. S. Sales Only). AECL $1.00.

Tertiary aliphatic amine extractants are being studied at the Whiteshell Nuclear Research Establishment for the recovery of plutonium from Canadian power reactor fuels. The analysis of the process solvent chosen, Alamine 336 in diethylbenzene, and the status of analytical development up to October 1971 is presented. Gas chromatography, infrared spectroscopy, and mass spectrometry are the main techniques used for the determination of the major constituents, and a number of trace impurities. Selective adsorption and concentration of trace impurities on activated alumina are used to facilitate the analysis of the impurities and to assess the need for process solvent purification. The effect of impurities on the plutonium extraction process is briefly discussed. (auth)

19755 (HW-27171) PUREX PROCESS PULSE COLUMN STUDIES WITH CCl_4 AS DILUENT. Richardson, G. L.; Sege, G. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). 7 Sep 1954. Contract W-31-109-eng-52. 87p. Dep. NTIS.

Declassified 31 Jan 1973.

Pulse column specifications have been developed for a Purex Plant capable of processing three to ten short tons of uranium per day. The process employs tributyl phosphate solvent with carbon tetrachloride as diluent. Flowsheet modifications necessary to permit the use of the heavier-than-water solvent mixture are described. (auth)

19756 (REG/G-3.3(1-73)) QUALITY ASSURANCE PROGRAM REQUIREMENTS FOR FUEL REPROCESSING PLANTS. (Directorate of Regulatory Standards (AEC), Washington, D. C.). 8 Jan 1973. 1p. DRS, Washington, D. C. Free.

19757 NUCLEAR POWER GENERATION AND NUCLEAR FUEL CYCLE. Shinohara, Y. (Tokyo Electric Power Co, Inc.). Kagaku Kogyo; 23: No. 3, 372-7(Mar 1972). (In Japanese).

Processes involved in the nuclear fuel cycle are briefly described including preparation, enrichment, and reprocessing of fuels for various types of reactors. (DHM)

19758 METHOD OF PROCESSING NUCLEAR FUELS. Avogadro, A.; Wurm, J. (to EURATOM). U.S. Patent 3,708,267. 2 Jan 1973. Priority date 25 Oct 1968, Netherlands. 4p.

In the processing of irradiated nuclear fuels containing uranium and plutonium, the fuel is first converted to a plutonium-containing alkali metal uranate. The uranate is suspended in a molten salt or salt mixture and treated with gaseous hydrogen chloride and oxygen, whereupon the uranium dissolved in the melt is separated from the undissolved plutonium compounds. (Official Gazette)

19759 PRESENT AND FUTURE APPLICATION OF SOLVENT EXTRACTION PROCESSES FOR THE REPROCESSING OF IRRADIATED NUCLEAR FUELS. Detilleux, E. (European Co. for the Chemical Processing of Irradiated Fuels, Mol, Belg.). Ingenieursblad; 41: 467-475(1972).

Solvent extraction, using tributyl phosphate as extraction medium, is the process universally adopted to recover and purify the plutonium and uranium contained in irradiated nuclear fuels. The extraction process is generally known as the Purex Process. This process is analysed to show how it fulfils the specific requirements defined. The permanent evolution of reactor technology modifies some of the characteristics of the spent fuels. The consequences of this evolution on the extraction process are discussed together with the means currently developed to secure the further use of liquid/liquid extraction as an industrial process. (auth)

19760 EXCHANGE AND REDUCING REACTIONS OF HYDROGEN TELLURIDE: RAPID RADIOCHEMICAL SEPARATION OF TELLURIUM. Tomlinson, L.; Hurdus, M. H. (Atomic Energy Research Establishment, Harwell, Eng.). Radiochim. Acta; 17: No. 4, 199-202(Nov 1972).

Hydrogen telluride was found to undergo the following reactions in aqueous solution: rapid isotopic exchange with tellurite; rapid reduction of selenite and arsenite to their respective hydrides. A method of separating tellurium from fission products, based on the exchange reaction between H_2Te and tellurite, is described. A chemical yield of 20% is obtained in 10 seconds with the following decontamination factors: As = 50, Se = 900, Ge = 1×10^4, Sn $\geq 5 \times 10^3$, Sb $\geq 9 \times 10^4$, Br $\geq 3 \times 10^3$, I $\geq 1 \times 10^5$. (auth)

19761 STUDY OF THE RATE OF EXTRACTION IN SYSTEMS WITH TRIBUTYL PHOSPHATE. IV. Extraction of $UO_2(NO_3)_2$ with Mixing in a Centrifugal Field. Pushlenkov, M. F.; Kuznetsov, G. I.; Schepetil'nikov, N. N.; Popkov, G. P.; Zelenin, L. I. Sov. Radiochem. (Engl. Transl.); 14: No. 2, 244-250(1972).

Translated from Radiokhimiya; 14: No. 2, 235-241(1972).

The rate of extraction of uranium in the system $UO_2(NO_3)_2$-HNO_3-H_2O-TBP-diluent in a centrifugal field was studied. It was shown that the kinetics of mass transfer under these conditions depends greatly on the rate of rotation of the apparatus. At a rate of rotation of 4000 rpm, the extraction process is virtually completed in 0.8 sec. For the system with carbon tetrachloride, the efficiency of the extraction process is approximately 30% greater than when a mixture of saturated hydrocarbons with boiling range 110 to 270°C is used as the diluent. The hydrodynamic characteristics of the centrifugal apparatus were investigated. Equations are cited for the calculation of the stratification chamber. It was established that the completeness of the separation of the phases is determined by the rate of flow of the phases, the rate of rotation of the apparatus, and the density differences of the phases. (auth)

ENGINEERING

Energy Conversion

Refer also to abstracts 19959, 21307, and 21977.

19762 (LA-DC-72-1480) NUCLEAR SAFETY IN NUCLEAR POWER AND PROPULSION DEVICES FOR SPACE. Graves, G. A. (Los Alamos Scientific Lab., N. Mex.). 1972. 36p. (CONF-721068-1). Dep. NTIS.

The use of nuclear devices in space systems may introduce them to a wide variety of abnormal or extreme conditions in the event of system malfunctions. Undesirable circumstances which could be encountered include explosion, fire, reentry, impact, and contact with land or water. But it does not follow that exposure to diverse and hostile environments need produce an event of nuclear consequence, i.e., one leading to significant fuel dispersal, criticality, or radiation exposure. Nuclear space systems can be studied on the ground and their nuclear safety characteristics verified or enhanced before their employment in space. Extensive research in this area has been carried on for many years in the United States and has led to the development of various means and policies through which safety is promoted or assured. These include special features in design, proscriptions on modes of operational use, and countermeasures directed at protecting against specific eventualities. Some examples of these approaches and of the research supporting them are given, and illustrative applications to isotope and reactor power supplies and to propulsion reactors are shown. (auth)

19763 STUDY OF ENERGY RECOVERY FROM CHARGED PARTICLES IN A SYSTEM OF SLOPED DIAPHRAGMS. Vinogradova, O. A.; Dimitrov, S. K.; Zhitlukhin, A. M.; Smirnov, V. M.; Tel'kovskii, V. G. At. Energ. (USSR); 33: No. 6, 969-974(Dec 1972). (In Russian).

A system of sloped diaphragms (SSD) having a dc decelerating and deflecting electrostatic field for direct energy recovery of a rarefied ion beam emerging from the expander in a thermonuclear mirror reactor is proposed. The line crossing the collecting diaphragms (electrodes) was chosen so as to minimize, on an average, its deviation from the tops of particle parabolic trajectories, i.e., points where particle energy is minimal. For a low-density plane beam (without space-charge effect) the theoretical efficiency may exceed 99%. In order to estimate the space-charge effect, the ratio d/r_{di} of a beam with d at the entrance angle of the recuperator to the Debye radius r_{di} of ions calculated from the initial longitudinal ion energy is used. Analytical and numerical investigations show that, for $d/r_{di} \approx 0.15$ to 0.20, i.e., corresponding to a full-scale reactor proposed by Post, the system efficiency with preliminary focusing may reach >90%. The experiment with a low-density beam ($d/r_{di} = 0.014$, current density $j = 3 \times 10^{-5}$ A/cm^2, d = 0.3 cm, ion energy $W_{max} = 4$ keV) gave an efficiency of 96% (with the estimated efficiency 97%). For a relatively dense beam $d/r_{di} = 0.04$) and a nonoptimum set of parameters without preliminary focusing and transverse energy recovery, the experimental efficiency was 88% (with an optimal estimated value of $\eta = 90\%$). Calculations and experimental results showed that the estimated η should not be too high (not more than 92 to 94%) to increase the system's stability with respect to errors in the beam orientation and the presence of transverse energy spread as well as the space-charge effect. The error in the efficiency value was 5%. (auth)

19764 CLOSED ENERGY CYCLE WITH AN MHD GENERATOR USING THE T-LAYER EFFECT. Slavin, V. S.; Sokolov, V. S. (Inst. of Theoretical and Applied Mechanics, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, No. 13, Ser. Tekh. Nauk; No. 3, 82-87(Oct 1972). (In Russian).

Many proposals have been made which utilize the so-called layer currents which have the purpose of enhancing the effectiveness of energy conversion in MHD-generators. The phenomenon of the T-layer development in a gas stream from some disturbance in the presence of an external magnetic field has been described earlier (1969). The possibility of using this T-layer in conjunction with a MHD-generator in closed energy cycles is examined. (KSW)

19765 ELECTROSTATIC PRINCIPLE ROTATING ATOMIC MOTOR. Dove, J. E. U.S. Patent 3,708,703. 2 Jan 1973. Filed date 9 Jun 1971. 4p.

A motor shaft rotates from energy derived from charged particles emitted from atomic waste materials. The particles are stored in the shaft and exit radially by influence of a surrounding electric field to be received in a collector material. Vanes radially disposed about the shaft exchange energy electrostatically with the moving particles. A magnetic field causes the particles to move toward the vanes as they radially proceed from the shaft. (Official Gazette).

19766 RELATION BETWEEN CURVE POWER FACTOR AND CONVERSION EFFICIENCY OF A SILICON SOLAR CELL. Rao, A. B.; Premnath (Indian Inst. of Tech., New Delhi). Indian J. Pure Appl. Phys.; 10: No. 7, 558-561(Jul 1972).

A comprehensive analysis of the relation between curve power factor (CPF) and conversion efficiency (η) of a silicon solar cell was made in terms of energy gap, resistivity of bulk silicon, series resistance, cell thickness, temperature, solar intensity, and nuclear particle radiation damage. There is no one-to-one correspondence between CPF and η as one usually expects. The ratio of CPF to η is found to be constant only when the series resistance is less than 4 to 5 ohms and at very low temperature. In all other cases the ratio is found to be a function of the different variables. (auth)

19767 THEORETICAL STUDY OF ENERGY RECOVERY FROM CHARGED PARTICLES IN THE SYSTEM OF SLOPED DIAPHRAGMS. Vinogradova, O. A.; Dimitrov, S. K.; Zhitlukhin, A. M.; Smirnov, V. M.; Telkovskii, V. G. (Moscow Engineering Physics Inst.). pp 89 of Fifth European conference on controlled fusion and plasma physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

The periodic electrostatic deceleration system proposed by Post for direct energy recovery from a beam of charged particles was studied. A dc electric field is applied to the recuperator; the line formed by the edges of the diaphragm is chosen such as to minimize the deflection of this field at the top of the parabolic trajectories. The efficiency of the System of Sloped Diagrams (SSD) for an ideal parallel beam without space charge may exceed 99%. With preliminary beam focusing and recovery of the transverse energy fraction, the efficiency for a full scale reactor may be >90%. (France)

19768 EXPERIMENTAL STUDY OF ENERGY RECOVERY FROM CHARGED PARTICLES IN THE SYSTEM OF SLOPED DIAPHRAGMS. Vinogradova, O. A.; Dimitrov, S. K.; Zhitlukhin, A. M.; Smirnov, V. M.; Telkovskii, V. G. (Moscow Engineering Physics Inst.). pp 90 of Fifth European conference on controlled fusion and plasma physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

The system of sloped diaphragms (SSD) was investigated experimentally in order to study the direct recovery of energy from the charged particles from a full-scale thermonuclear mirror reactor. Certain parameters are calculated under conditions of negligible space charge for an N^+ ion beam deceleration system (maximum energy $W_{max} = 4$ keV, ion current density $j = 3 \cdot 10^{-5}$ A/cm^2, initial diameter d = 0.3 cm, divergence angle $\theta = \pm 1°$. These parameters are compared with experimental values. (France)

Facilities and Equipment

Refer also to abstracts 20294, 21619, and 21867.

19769 (RDT-E-1-37-T(2-73)) BALANCED SAFETY RELIEF VALVES FOR LIQUID METAL FACILITY GAS SYSTEMS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Feb 1973. 20p. RSO.

A standard prescribing requirements for balanced relief valves for liquid metal facility gas systems is presented. (auth)

19770 (RDT-E-11-2-T(1-73)) FILTER FOR SODIUM SERVICE. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1973. 16p. RSO.

A standard prescribing requirements for sodium filters for nuclear and associated applications is presented. (auth)

19771 (REG/G-3.2(1-73)) EFFICIENCY TESTING OF AIR-CLEANING SYSTEMS CONTAINING DEVICES FOR REMOVAL OF PARTICLES. (Directorate of Regulatory Standards (AEC), Washington, D.C.). 8 Jan 1973. 1p. DRS, Washington, DC Free.

19772 DETERMINATION OF STAGE MASS MEDIAN DIAMETERS FOR CASCADE IMPACTORS USING PARTICLE-SHAPE FACTORS. Kotrappa, P. (Bhabha Atomic Research Centre, Trombay, India). J. Aerosol Sci.; 4: No. 1, 47-49(Jan 1973).

Recent work on the discrepancy between stage constants of the cascade impactor as determined for spherical particles and those for particles of irregular shape is reviewed. It was concluded that the use of experimentally determined shape factors brings the data obtained with irregularly shaped particles into close agreement with data for spherical particles of known density. (RCK)

19773 TURBULENT BED COOLING TOWER. Barile, R. G.; Meyer, D. W. (Purdue Univ., Lafayette, IN). Chem. Eng. Progr., Symp. Ser.; 67: No. 119, 134-143(1971).

A fluidized bed is being developed for use as a new type of cooling tower for heated power-plant cooling water. The device is a cylindrical bed of low-density spheres fluidized by ambient air and sprayed with hot water from the top. Pressure drop has been measured, liquid holdup has been calculated, and correlations are presented. Flow regimes and flooding are also considered. Heat transfer models are formulated and a turbulent bed cooling tower design is compared to an existing induced draft, cross flow tower. Holdup and pressure drop are found to be functions of the liquid-particle Reynolds number, liquid Froude number, packing depth, and particle size. The turbulent bed cooling tower will require less capital investment and more power cost than conventional cooling towers. (auth)

19774 RELIABILITY ANALYSIS OF MECHANICAL COMPONENTS AND SYSTEMS. Kececioglu, D. (Univ. of Arizona, Tucson). Nucl. Eng. Des.; 19: No. 2, 259-90(1972).

From first international conference on structural mechanics in reactor technology; Berlin, Germany (20 Sep 1971). See CONF-710903-(Vol.19,No.2).

A six-point comprehensive definition of reliability is given and discussed. A fifteen-step "Design by Reliability" methodology is presented and illustrated. Methods for synthesizing the failure governing stress and strength distributions, and for calculating the associated reliability, are presented and illustrated. A method for determining the lower, one-sided confidence limit of the calculated reliability is given and illustrated. The data requirements for this design methodology are discussed, and such data generated at the Reliability Research Laboratory of the University of Arizona are presented. The methodology is compared with the conventional safety factor approach and a unification of the statistical safety factor with the reliability is given. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 20304, 21039, 21577, 21614, 21969, and 21974.

19775 (AECL-4309) THERMAL BEHAVIOUR OF A HEATED SURFACE AT AND BEYOND DRYOUT. Groeneveld, D. C. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs). Nov 1972. 330p. Dep. NTIS (U. S. Sales Only). AECL $4.00.

Thesis. Submitted to Univ. of Western Ontario, London, Can.

Axial temperature distributions at and beyond dryout were measured in Freon-12 flowing vertically upwards in a uniformly heated tube. The parametric effects of quality, mass flux, and heat flux were investigated. A parallel photographic study gave helpful information on the flow structure at the conditions under investigation. The results show that, in uniformly heated channels, the steep temperature gradient at dryout causes the surface heat flux to display a maximum just before dryout and a minimum just after. At high mass flows and void fractions between 20 to 80% dryout may occur upstream from the outlet end. From the results a dryout map was constructed. This map predicts which type of dryout is most prevalent at certain mass flux-quality combinations. An existing post-dryout model was extensively modified. It was found to predict accurately both water and Freon-12 post-dryout temperatures. A physical explanation for the upstream dryout phenomenon is offered. This model has been extended to the post-dryout regime and correctly predicts rewetting downstream from an upstream dryout. The criterion for rewetting is that the heated surface temperature falls below the "maximum liquid temperature." Methods used to evaluate the maximum liquid temperature are given; they agree with experimentally measured maximum liquid temperatures. (auth)

19776 (CONF-650670-3) SOME HYDRODYNAMICAL ASPECTS OF ANNULAR DISPERSED FLOW: ENTRAINMENT AND FILM THICKNESS. Truong Quang, M.; Huyghe, J. D. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 1965. 14p. Dep. NTIS (U.S. Sales Only).

From Symposium on Two-Phase Flow; Exeter, United Kingdom of Great Britain and Northern Ireland (UK) (20 Jun 1965).

Hydrodynamic investigations were carried out on the subject of adiabatic vertical upward flowing gas-liquid mixtures under annular dispersed conditions, with measurement of droplet entrainment by the gas core and mean film thickness and with observation of the interface aspect. The experiments were carried out with flows of air-water and air-ethyl alcohol mixtures in 6mm and 12mm bore tubes. The entrainment fraction was measured by allowing the film to discharge through an annular slot of variable width in the tube wall. The ratio between liquid film and total liquid flow rates was found to depend on the volumetric kinetic energy of the gaseous core, also on the liquid flow rate and physical properties of the liquid phase. An empirical correlation was established. The liquid film characteristics were measured by photographing instantaneous film profiles. By this method, which appears to be reliable as it requires no interpretation, the mean liquid film thickness was measured and the aspect of the interface observed. The mean film thickness depends on the volumetric kinetic energy of gas phase but not on the total liquid flow rate. Two different interface aspects were observed, one with conventional roll waves occurring at low gas core kinetic energy, and the other of the "squall surface" type without roll waves, at high kinetic energy. (auth)

19777 (SFB-MHD-5) FRICTIONLESS EQUILIBRIUM FLOW OF A ONE-COMPONENT-TWO-PHASE MIXTURE WITH SMALL STEAM CONTENT IN CONVERGENT-DIVERGENT NOZZLES. (Isentropic flash evaporation). Staedtke, H. (Technische Universitaet, Berlin (West Germany)). Mar 1972. 67p. (In German). Dep. NTIS (U. S. Sales Only).

The isentropic flow of evaporating two-phase mixtures in convergent-divergent nozzles was studied. It is shown that the frictionless equilibrium two-phase flow with homogeneous distribution of both phases throughout the entire flow channel can be treated as a single-phase gas flow. The quantitative deviation from single-phase gas flow arises only through the differences in the state equations for two-phase mixtures. (auth)

19778 SOLUTION OF THE UNSTEADY DIFFUSION EQUATION IN AN ARBITRARY, DOUBLY CONNECTED REGION. Laura, P. A.; Ercoli, Ruben (Univ. Nacional del Sur, Bahia Blanca, Argentina). Nucl. Eng. Des.; 23: No. 1, 1-9(1972).

The analysis of many problems of importance in modern technology involves solution of differential systems in domains of "exotic" boundary shape. Typical examples are solid propellant rocket motors, electromagnetic and acoustical waveguides, conduits commonly used in space vehicles, graphite bricks of gas-cooled nuclear reactors, etc. In the case of a solid propellant rocket motor, a simplified but logical mathematical model is an infinitely long, circular cylinder with a star-shaped perforation. Such a geometry offers serious mathematical difficulties, and similar situations arise in the other examples previously quoted. An approximate solution for the diffusion equations in an arbitrary doubly-connected domain by means of conformal mapping is presented. Since the governing equation is not invariant under transformation, a variational approach is used to solve the transformed differential equation. A unique solution valid for any doubly-connected region is obtained in this manner. (auth)

19779 EFFECT OF SUPERHEAT ON FILM CONDENSATION OF POTASSIUM. Sakhuja, R. K. (Thermo Electron Corp., Waltham, MA); Rohsenow, W. M. Chem. Eng. Progr., Symp. Ser.; 67: No. 119, 94-110(1971).

Heat transfer during film condensation of superheated vapors of liquid metals, in particular, to determine the value of the condensation coefficient which appears in the basic interphase mass transfer analysis was studied. Previous experimenters have reported a deterioration in condensation heat transfer due to the presence of superheat in the vapor. Copper condensing blocks are used for enhanced precision of measurement. Data obtained in this investigation indicates no dependence of the condensation coefficient on the amount of superheat present in the vapor. It is observed that the condensation coefficient has a constant value of unity and is independent of pressure level. The pressure range covered in this investigation is from 0.007 atm to 0.075 atm and the range of vapor superheat is from 0 to 100°F. It is further shown that reported dependence of the condensation coefficient during film condensation of saturated liquid metal vapors on pressure may be attributed to the presence of non-condensables in the system. It is observed that a successively cleaner system, freer of non-condensables, yields a condensation coefficient which approaches unity asymptotically. (auth)

19780 NON-STEADY FLOW OF A CONDUCTING BINGHAM FLUID IN AN ANNULUS IN PRESENCE OF TIME-VARYING TOROIDAL PRESSURE GRADIENT. Tandon, P. N.; Raisinghania, M. D. Indian J. Theor. Phys.; 20: No. 2, 53-61(Jun 1972).

Unsteady flow of a conducting Bingham fluid in an annulus is discussed. It was assumed that a constant radial magnetic field acted on the fluid and that no applied or polarization voltages exist, i.e., no energy is added or extracted by electrical means.

It was observed that the toroidal component of the velocity in Bingham fluid was greater than that of viscous fluid and that it increased as the value of the non-dimensional Bingham number increased. (auth)

19781 STUDY OF FISSION-FRAGMENT-INDUCED NUCLEATION OF BUBBLES IN SUPERHEATED WATER. Deitrich, L. W.; Connolly, T. J. (Stanford Univ., CA). Nucl. Sci. Eng.; 50: No. 3, 273-282(Mar 1973).

A study of bubble nucleation by fission fragments in superheated water is described. The experimental work was conducted using a small bubble chamber especially built for the program. The minimum superheat necessary for nucleation of visible bubbles by fission fragments (the threshold) was measured at temperatures between 380 and 440°F. Predictions of the threshold are based on comparison of the energy and linear energy transfer (LET) of fission fragments with the values required for bubble nucleation. Because of the variation in fission-fragment energy, the comparison is made on the basis of the median, 80'th percentile, and maximum energy and LET of the fragments present in the experiment. The data indicate that the LET comparison is the appropriate basis for prediction of the threshold. Using an empirically adjusted value of the LET required for nucleation, the calculated threshold agrees reasonably well with the data but becomes increasingly discrepant with increasing temperature. Reasons for deviation of the data from predictions are discussed, but a definitive determination cannot be made on the basis of the available data. (auth)

19782 DETERMINING THE TURBULENT EXCHANGE COEFFICIENTS IN TUBE BUNDLES SWEPT BY TRANSVERSE FLOW. Guelich, J. (Winterthur Engineering Works Div., Switzerland). Sulzer Tech. Rev.; No. Nuclex 72, 73-80(1972).

The turbulent exchange coefficients in the range $7 \times 10^3 < Re < 1.5 \times 10^5$ were determined on an in-line tube bundle under transverse flow with concentration measurements. The results are presented in the form of a Pe number whose upper limit can be reproduced by the correlation $Pe = 12{,}600 \cdot Re^{-0.71}$ with an uncertainty of from 20 to 30%. In the range $1.5 \times 10^4 < Re < 10^5$ irregularities were observed in the bundle flow, manifesting themselves in the form of marked variations in concentration, better mixing and a rise in the pressure loss coefficient. Together with the theory stated, the results provide the basis for predicting the temperature profiles normal to the direction of flow which establish themselves in cross-flow heat exchangers as a result of disturbances. (auth)

Materials Testing

Refer also to abstracts 20308–20311, 20359, and 20377.

19783 (EURISOTOP-53) TESTING OF CONCRETE BY GAMMAGRAPHY. Report on a Demonstration and Lecture Organization of the Buros Eurisotop, June 11, 1969, Netherlands. Cabos, H. P. (Comp.) (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). 1971. 57p. (In German). Dep. NTIS (U.S. Sales Only).

A lecture and demonstration series on the gammagraphic testing of concrete was developed for presentation in the Netherlands and Italy. The Niedermarsberg presentation is compiled. The contribution of the Deutsche Bundesband to the development of radiometric testing methods is outlined. The problem of nondestructive testing in reinforced concrete is discussed. The reasons for the selection of the construction chosen for the demonstration are given. The gammagraphic testing of concrete and radiometric testing methods for supports and reinforced concrete are described. The radiographic testing of the Klingerbach and Kroegersgrund bridges in the demonstration of gammagraphic techniques is described. (JSR)

19784 UTILIZATION OF ACCELERATORS IN RADIATION FLAW DETECTION. Berdonosov, A. A.; Prokof'ev, Yu. S. (Scientific Research Inst. for Electronic Inspection, Tomsk, USSR). Defektoskopiya; No. 5, 94-97(1972). (In Russian).

The economics and effectiveness of using an accelerator (betatron, linear accelerator, etc) in production quality control were investigated with respect to two aspects: the economic aspect of the most effective of several alternative methods, and the establishment of the feasibility of control with the objective of preventing (decreasing) rejects, enhancing the useful life, and the reliability of the product under control. Formulas are introduced for computing the economic effect: a sample computation using the formulas yielded the approximate operating cost of 85,000 rubles/yr. (KSW)

19785 IMMERSION TECHNIQUE DEVICE FOR AUTOMATIC TESTING OF QUALITY TUBES. Schubert, K. (NUKEM GmbH, Wolfgang, Ger.). Kerntechnik; 14: No. 12, 570-573(Dec 1972). (In German and English).

This communication describes a tube testing facility developed specially for reactor fuel rod cladding tubes. The tubes passing through the facility are tested for defects, wall thickness, outer diameter and inner diameter are checked; the results are recorded, and the locations of defects are marked on the tubes. The facility is equipped with an automatic sequential control system for the testing and the transport of the tubes, including sorting of the tested tubes. (auth)

19786 COMPACT NEUTRON RADIOGRAPHY FACILITY EMPLOYING A SEALED-OFF TUBE. Cesareo, R. (Inst. of Physics, Rome); Frazzoli, F. V.; Mancini, C.; Sciuti, S.; Storelli, L. Kerntechnik; 14: No. 12, 561-565(Dec 1972). (In German and English).

A neutron radiography facility is described which is intended for use in applied research laboratories. A sealed-off tube neutron generator has been employed whose output is 3×10^{10} fast neutrons per second. Neutron radiographs may be obtained in a few minutes through a direct method. Some preliminary results are given on the use of an image intensifier. (auth)

19787 RADIOGRAPHY VERSUS ULTRASONIC TESTING. Karlsen, F. Non-Destruct. Test.; 5: No. 6, 340-343(Dec 1972).

Radiography and ultrasonics are both widely used in the inspection of weldments and other structures. The choice of method depends on the economics and technical considerations based on the end use. The applicability of the methods is discussed and a greater use of ultrasonics for weldment inspection is advocated. (auth)

Nuclear Explosions

Refer also to abstracts 19847, 19960, 19961, and 20070.

19788 (AD-749894) UTILITY OF TSAI'S METHOD FOR SEISMIC DISCRIMINATION. Semiannual technical report No. 2, 1 January–30 June 1972. Tsai, Y.-B. (Texas Instruments Inc., Dallas). 15 Jul 1972. Contract F44620-71-C-0112. 61p. (AFOSR-TR-72-1936). NTIS.

The divergence of the M(s) vs m(b) data for earthquakes and underground nuclear explosions is shown to result primarily from the difference in source mechanisms and focal depths. It is demonstrated further that both the source dimension and the source time function are jointly responsible for causing the difference in source spectra for the two different types of seismic events. The source spectra of underground nuclear explosions are expressed in terms of the parameterized reduced displacement potential function. (auth)

19789 (FOA-4-4468-26) IDENTIFICATION OF EARTHQUAKES AND EXPLOSIONS WITH SEISMIC DATA FROM HAGFORS OBSERVATORY. Israelson, H. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Jun 1971. 23p. Dep. NTIS (U. S. Sales Only).

The capabilities of various seismological identification criteria for earthquakes and underground nuclear explosions have been tested using data from the Hagfors Observatory in Sweden. In all some 70 events from the US and USSR including 8 presumed Kazakh and 22 announced Nevada explosions were analyzed. The data are too few for a rigorous statistical analysis but some general conclusions may be drawn. For both the US and USSR events the $m_b(M_S)$ method appears to provide a more efficient discrimination than the short-period methods using spectral ratios or complexity. The data also indicate that the degree of separation between explosions and earthquakes is best for USSR events for all discriminants tested. (auth)

19790 (NVO-1163-234) SEISMIC SOURCE FUNCTIONS FOR CLOSELY-SPACED SIMULTANEOUS NUCLEAR DETONATIONS. Murphy, J. R.; Hewlett, R. A. (Environmental Research Corp., Las Vegas, Nev.). Feb 1973. Contract AT(292)-1163. 58p. Dep. NTIS.

A mathematical model is described which can be used to approximate nuclear seismic source functions for closely-spaced, simultaneous nuclear detonations. This model allows the stresses acting on a spherical surface enclosing the source region to be a function of position describable as a superposition of Legendre polynomials and their derivatives. Fundamental solutions are derived for even Legendre functions up to and including degree six. An application is made to the proposed Rio Blanco Plow-

share experiment in which the assumed stress distribution on an enclosing sphere is represented as a superposition of Legendre functions with complex coefficients. The resulting far-field velocity spectra indicate relatively strong shear wave excitation and a complicated angular dependence for both the compressional and shear wave spectra. (auth)

19791 (UCRL-51296) MECHANICAL PROPERTIES OF GRANITE FROM THE TAOURIRT TAN AFELLA MASSIF, ALGERIA. Schock, R. N.; Abey, A. E.; Heard, H. C.; Louis, H. (California Univ., Livermore. Lawrence Livermore Lab.). 8 Nov 1972. Contract W-7405-eng-48. 19p. Dep. NTIS.

The mechanical properties of a granite from the French Hoggar test site in Algeria were measured to provide input for numerical codes seeking to predict rock response to a stress wave and to assist in formulating models on which these codes are based. The measured properties include pressure-volume behavior, failure envelope as a function of mean pressure, compressional and shear velocities as a function of pressure, and three-dimensional stress-strain measurements along various loading and unloading paths. This granite responds to stress in much the same way as other granites that have been studied extensively. The failure envelope was determined to 30-kbar mean stress with no evidence of ductile behavior. Stress-strain experiments reveal the presence of long narrow cracks which close at stress levels below 0.5 kbar. The rock at atmospheric pressure was found to have a bulk modulus of 330 kbar and a shear modulus of 290 kbar. These yield an elastic compressional velocity of 5.24 km sec^{-1}, in good agreement with laboratory measurements on small samples and with field experiments within the massif over distances of several tens of meters. (auth)

19792 (UCRL-Trans-10676) MECHANICAL EFFECT OF AN UNDERGROUND EXPLOSION. Rodionov, V. N.; Adushkin, V. V.; Kostyuchenko, V. N.; Nikolaevskii, V. N.; Romashov, A. N.; Tsvetkov, V. M. Mar 1973. Translation by Robert Addis of Mekhanicheskii Effekt Podzemnogo Vzryva, Izdatel'stvo, Nedra, Moscow, 1971. 294p. Dep. NTIS.

This book presents the first schematic description of all the basic characteristics of an underground explosion's mechanical effect. For calculating the mechanical motion it offers a scheme that makes it possible to predict the dimensions of the explosion cavity, of the zones of rock fracturing and crushing, of the craters produced by cratering explosions, as well as the intensity of the seismic waves. The theoretical results are compared with experimental findings from field and laboratory tests conducted in the USSR and other countries. Possible uses of powerful underground explosions are discussed. A detailed account is given of the unique explosions in Medeo (used to build a dam against flash flooding) and of those at Balpazy (used to dam the river Vakhsh). The Appendix gives the solutions of theoretical model-problems on which the main calculation scheme is based. The most important mechanical properties of rock that govern the parameters of an underground explosion are analyzed, and three further studies are described. The book contains 37 tables, 76 figures and a bibliography of 180 references. (auth)

19793 (USGS-474-157) VELOCITY CROSS SECTION 7, EXTENDING SOUTH-SOUTHEAST FROM TATUM DOME, LAMAR AND PEARL RIVER COUNTIES, MISSISSIPPI. Dribble-24. Eargle, D. H.; Black, R. A.; Davis, B. O.; Stanford, J. F. (Geological Survey, Denver, Colo.). Aug 1962. Contract AT(29-2)-474. 7p. Dep. NTIS.

Velocity cross section 7 extends about 24 miles south-southeast from Tatum salt dome, south-central Lamar County, Miss., to the central part of Pearl River County. The line of section crosses no known structural anomalies. Cross section 7 shows major sonic velocity zones (and lateral variations of sonic velocity within these zones) for a region with a radius of about 25 miles of Tatum salt dome. Tatum dome is the site proposed for a series of seismic experiments (Dribble Project) for improving the detection of underground nuclear explosions. Data on sonic velocities of the sedimentary rocks surrounding Tatum dome are required for planning of instrumentation for recording the proposed seismic events and in the interpretation of the recorded seismograms. (auth)

19794 REDUCTION OF RADIOACTIVE GAS CONTAMINATION OF NUCLEAR DETONATIONS IN GEOLOGICAL FORMATIONS. Heckman, R. A.; Cowles, J. O. (to United States Atomic Energy Commission). U.S. Patent 3,703,208. 21 Nov 1972. Filed date 22 Jan 1971. 12p.

Oxidizing agents are placed circumjacent to a nuclear explosive device detonated in a geological formation, generally a carbonaceous or petroliferous formation, to provide a more oxidizing environment thereabout. Upon detonation of the device reductants present in the formation as well as in emplacement components are oxidized. Consequently tritium produced by the detonation together with any hydrogen gas present tends to be oxidized to form a tritiated water product. The water combines with inorganic materials in the vicinity of the detonation and is immobilized or falls to the bottom of the cavity so as to minimize the tritium content of organic materials evolved by the formation. (Official Gazette)

19795 TELLURIAN OPTOEXPLOSIVE SYSTEM INCLUDING NUCLEAR EXPLOSIVE LIGHT GENERATOR AND TARGET IRRADIATION. DeMent, J. U.S. Patent 3,715,596. 6 Feb 1973. Filed date 7 Aug 1968. 82p.

This disclosure relates to a tellurian (underground) system (an explotron) for the close-in treatment of an irradiable target by explosion-formed electromagnetic energies characterized as reflectable off a frangible reflective optic such that the target is not overwhelmed by non-reflectable explosion energies like blast and plasma. A typical tellurian explotron is a main duct horizontally sited below the ground, within one end of which is positioned and fired a mass of chemical or nuclear explosive (the optoexplosive) that generates electromagnetic and kinetic energies. Junctured midway or at any other convenient site along the main duct is at least one ductoid branch member, which rises to the ground surface and couples with the irradiable target. At the furcation of main duct and branch there is emplaced at a suitable angle a frangible reflective optic such as an aluminum foil mirror which delivers the faster-moving, reflectable radiation via the branch to the target, while the slower-moving, non-reflectable energies transit the main duct and break out the frangible reflective optic, being deposited in the opposite end of the main duct (the shock sink). (Official Gazette)

19796 HEURISTIC CRITERION FOR DISTINGUISHING BETWEEN EARTHQUAKES AND SUBTERRANEAN NUCLEAR EXPLOSIONS. Bormann, P. Monatsber. Deut. Akad. Wiss. Berlin; 13: No. 10-12, 843-846(1971). (In German).

A heuristic summation criterion which yields a quantitative value for the complexity of seismic records is described. The determination can be performed either manually or can be easily automated. The criterion was tested on short-term wide-band recordings of high magnification which registered most of the seismic events. At the Moxa station, it was possible to identify 96% of the earthquakes and 75% of the underground explosions. Records of the remaining explosions were too weak for identification. (HBG)

Protective Structures and Equipment

Refer also to abstract 20152.

19797 (BNWL-B-125) FILTER EFFICIENCY TEST: PUREX PLANT VENTILATION EXHAUST FILTERS. Schwendiman, L. C. (Battelle Pacific Northwest Labs., Richland, Wash.). 1 Sep 1971. Contract AT(45-1)-1830. 16p. Dep. NTIS.

The efficiency of the two ventilation filters in use at the Purex Plant was measured. Three tests were conducted to measure the efficiency of these filters. Technical grade fluorescein was used as the indicator particles, which were generated by aspiration from an alcohol-water solution. The mass mean aerodynamic size of these particles was 0.42μ, 0.3μ, and 0.3μ in the three runs, respectively. Size distributions were determined during the three tests with a Scientific Advances 7-stage cascade impactor. Absolute efficiencies greater than 99.5% were measured in all tests for both filters, except in two tests which yielded greater than 99.3%. The "greater than" values were conservatively calculated by assuming that any measurable fluorescence extracted in the samples drawn from downstream of the filters was attributable to fluorescein particles which had penetrated the filters. Samples taken as background blanks prior to two of the tests showed fluorescence approximating that obtained from the test samples. The methods for determining the efficiency of the filters and the results of the measurements are presented. (auth)

Safety Engineering

Refer also to abstracts 19659 and 19762.

Vacuum Engineering

Refer also to abstract 21522.

19798 (IA-1271(Pt.1)) VACUUM TECHNOLOGY. Roth, A. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Oct 1972. 254p. Dep. NTIS (U.S. Sales Only).

The text of a Postgraduate Course given at the Faculty of Engineering of the Tel-Aviv University is presented in two volumes. In the first volume, after an introduction dealing with the main applications and history of vacuum technology, the relevant aspects of rarefied gas theory are discussed and molecular, viscous and intermediate flow through pipes of simple and complex geometry treated in detail. Relevant physicochemical phenomena (evaporation-condensation, sorption-desorption, permeation) are presented. (auth)

19799 (IA-1271(Pt.2)) VACUUM TECHNOLOGY. Roth, A. (Israel Atomic Energy Commission, Yavne. Soreq Nuclear Research Center). Oct 1972. 350p. Dep. NTIS (U.S. Sales Only).

The second half of a postgraduate text on vacuum technology is presented. Information is included on pumping and measuring techniques and special techniques used for obtaining and maintaining high vacuum, such as sealing techniques and leak detection. (auth)

19800 ANALYSIS OF RESIDUAL GASES IN ULTRAHIGH VACUA. Souchet, R. (Ecole Normale Superieure, Orsay, France); Sarrau, J.; Valdener, G. Vide; 27: No. 159, 125-142 (May 1972). (In French).

The fundamental physical basis of residual gas spectrometry is discussed, i.e., on a scale restricted to the first 100 mass units. A definition of the resolving power of the spectrometer is given. The various peaks appearing in the analysis of a given gas are reviewed together with the dependence of the sensitivity of the spectrometer on the nature of the gas and the setting up of the equipment. A method for interpreting the spectra is presented. This method was applied to the analysis of residual atmosphere and the degassing of various materials. (FR)

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Refer also to abstract 19873.

19801 (GJO-100) STATISTICAL DATA OF THE URANIUM INDUSTRY. (Grand Junction Office (AEC), Colo.). Jan 1972. 63p. Dep. NTIS.

Historical facts and figures concerning the uranium industry through 1971 are presented as statistical data. The statistics cover the period from 1968 through 1971. The data include: ore and concentrate purchases; ore production, ore reserves, and potential resources; distribution of deposits; drilling statistics; industry exploration expenditures; land holdings for uranium mining and exploration; employment; commercial U_3O_8 sales and requirements; and processing mills. (ERB)

19802 GEOLOGICAL SURVEY RESEARCH 1972. U. S. Geol. Surv., Prof. Pap.; No. 800-A, 1-320(1972).

A summary of recent significant scientific and economic results is presented. This is accompanied by a list of geologic and hydrologic investigations in progress and a report on the status of topographic mapping. (MCG)

19803 CAUSES OF LOCALIZATION OF URANIUM MINERALIZATION IN AUREOLES OF GRANITOID CONTACT METAMORPHISM. Sokolova, N. T.; Acheev, B. N. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya; No. 12, 1582-1594(Dec 1972). (In Russian).

Causes of the localization of hydrothermal uranium within zones of exocontact metamorphism are considered. In effusive-sedimentary rocks of complicated lithological composition contact metamorphism creates a medium chemically favorable to ore deposition, metamorphic rocks which in their chemical composition are similar to basic ones. Interaction of these rocks with ore-bearing solutions leads to active uranium deposition. The latter determines the localization of uranium mineralization within zones of metamorphism, prevailingly in metamorphic rocks of basic composition, acid metamorphic rocks being of substantially lesser importance. (auth)

19804 SUBSTANCE MIGRATION WITH SODIUM METASOMATOSIS AND URANIUM ORE FORMATION (URANIUM ORE MANIFESTATION IN SODIUM–URANIUM FORMATION). Zinchenko, V. A.; Rakovich, F. I. (Inst. of Geochemistry and Mineral Physics, Kiev). Dopov, Akad. Nauk Ukr. RSR, Ser. B; No. 11, 973-976(Nov 1972). (In Ukrainian).

Substance migration with sodium metasomatosis and uranium ore formation was established by a direct comparison of chemical analyses of granites and gneisses and ore-free and ore-bearing apogranite and apogneiss albitites. Conclusions on substance supply and evacuation resulted from the comparison of chemical analyses were substantiated by means of mathematical statistics. (auth)

19805 CONTENTS OF RADIUM AND THORIUM IN THE SOILS OF ARMENIA. Ananyan, V. L.; Avetisyan, A. Sh. Soobshch. Inst. Agrokhim. Probl. Gidroponiki, Akad. Nauk Arm. SSR; No. 11, 5-13(1971). (In Russian).

Studies have shown that the contents of radium and thorium are largely linked with the characteristics of soil-forming rocks. There is no solid link between the humus and calcareousness of radioactive elements. In chernozem soils the contents of radioactive elements increases to some extent. (auth)

Radioactive Effluents

Refer also to abstract 19771.

19806 (CEA-N-1548) APPLICATION OF CORRELATION METHODS TO ATMOSPHERIC DIFFUSION. Logre, P.; Rigot-Muller, F. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Nov 1972. 15p. (In French). Dep. NTIS (U.S. Sales Only).

In order to study the diffusion of pollutants in the atmosphere (above real sites), the atmosphere is considered to be a linear filter; signal analysis techniques are used to study the various processes taking place. The impulse response of the filter is defined in the pollutant-time plane. A short distance diffusion experiment is described and various information is given: transport velocity, stationary interval, and statistical validity. (France)

19807 (RT/PROT-(72)32) TRANSPORT AND DIFFUSION OF EFFLUENT GASES FOR A GREAT DISTANCE: CONSIDERATION AND CALCULATION FOR ANALYSIS OF HEALTH PROTECTION. Cagnetti, P.; Pagliari, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 5 Sep 1972. 49p. (In Italian). Dep. NTIS (U.S. Sales Only).

A method is described for calculating the concentrations of radioactive gases in the atmosphere and at ground level at various distances up to 100 km from the point of release during reactor accidents. Atmospheric diffusion along the trajectory as a function of time, precipitation, and wind velocity are used in two solutions based on the stability of the gases. The deposition on the ground due to washout was also calculated as a function of time. (CH)

19808 RADIOACTIVE FALLOUT IN THE AGRICULTURAL DISTRICTS. Hvinden, T. (Forsvarets Forskningsinstitutt, Kjeller, Norway). Sivilt Beredskap; 15: No. 2-7(1972).

Radioactive fallout in agricultural districts will threaten the local population and those evacuated from the towns, animals, drinking water and food, crops, pasture, seed, and earth. In the first hours, or day or two, protection against external radiation is important. During this period too, potential internal radiation is in dust form. Afterwards, in the first three months ^{131}I in milk presents the main problem, followed by ^{89}Sr and ^{90}Sr in milk and ^{137}Cs in milk and meat. Animals with radiation injuries should be slaughtered as soon as possible. (INIS)

19809 SELECTION OF A SITE FOR THE GROUND DISPOSAL OF RADIOACTIVE WASTES. II. Selection of a ground disposal site of radioactive wastes by the sensitivity analysis. Inoue, Y.; Morisawa, S. Kyoto Univ. Nippon Genshiryoku Gakkaishi; 14: No. 12, 652-660(1972). (In Japanese).

The desirable conditions for ground disposal sites of radioactive wastes and an approximate method of estimating the internal dose are discussed. Sixteen of 26 environmental factors and three ecological transport paths of radionuclides through which leaked radionuclides migrate (i.e., the path of drinking water, sea foods and vegetables) are quantitatively examined by sensitivity analysis. The relationships existing between the internal dose and each environmental factor are shown in the accompanying table. The difference between the strict and approximate calculations of the internal dose are also examined, and the approximation is shown to be quite valid particularly for the rough estimation of the safety of a ground disposal site for radioactive wastes. (auth)

Radioactivity Monitoring and Transport

Refer also to abstracts 20164, 20177, and 21983.

19810 (BLG-467, pp 4.1-11) SAFETY STUDIES.

BELGIUM—fallout monitoring in, during 1971
CONTAMINATION—monitoring of environmental, in Belgium during 1971
FALLOUT—monitoring in Belgium during 1971
INDUSTRIAL WASTES—processing of, Belgian research programs on
NUCLEAR MATERIALS MANAGEMENT—safeguards system for, Belgian research programs on
RADIATION DOSIMETRY—development in Belgium, research progress on
RADIOACTIVE WASTE—management of, Belgian programs on (JRD)

19811 (IS-3048) SURVEY OF ENVIRONMENTAL RADIOACTIVITY, JANUARY 1–DECEMBER 31, 1972. Voss, M. D. (Ames Lab., Iowa). Feb 1973. Contract W-7405-eng-82. 44p. Dep. NTIS.

The environmental program consists of determinations of gross alpha and beta radioactivity in air, soil, vegetation, river water, ALRR outfall, bottom sediment, precipitation, well water, and pond water samples. The ALRR reached full power as of 7/12/65 and had generated 170,110 megawatt hours as of 12/31/71. A total of 28,461 megawatt hours was generated in 1972. Off-site environmental air is routinely monitored at a station atop the Research Building, Iowa State University campus, Ames, Iowa. The average radioactivity concentration in air for 1972 was 3.0×10^{-15} μCi/ml α and 1.2×10^{-13} μCi/ml β. This is the normal background at the sampling location. There was no measurable increase in airborne radioactivity attributable to Ames Laboratory operations. The alpha and beta radioactivity in stream water was determined upstream and downstream from the confluence point of streams

forming the drainage pattern from the ALRR. The average concentration during 1972 for all samples not in the direct flow (upstream) was 7.2×10^{-10} μCi/ml α and 6.5×10^{-9} μCi/ml β. In the direct flow pattern (downstream) the average concentration was 6.3×10^{-10} μCi/ml α and 5.7×10^{-9} μCi/ml β. There is no measurable radioactivity in the stream water samples attributable to Ames Laboratory operations. (auth)

19812 (KURRI-TR-101) LOG 8 OF RADIATION MONITORING WITHIN LABORATORY BUILDINGS (1971). Katsurayama, Y.; (and others) (Kyoto Univ. (Japan). Research Reactor Inst.). 1972. 28p. (In Japanese). Dep. NTIS (U. S. Sales Only).

The activities of the group engaged in monitoring radiation levels at all activities of the Kyoto University Reactor Research Institute for the year extending from January through December, 1971 are reported. Trends were recently observed in increased concentrations of radioactive gas both in the reactor chamber and in the stack gas. An inspection group was formed during February to investigate the source of this activity. The results obtained by this group along with its recommendations are given. There also was increased utilization of the heavy water irradiation facility as a result of which it was designated a high-dose-rate area. The monitoring instruments used at this laboratory have been in use for 7 to 8 years and many of the instruments are beginning to show the effects of wear. The malfunctioning rate is seen to be on a decided upswing. The different types of measurements reported in the past are also included in this annual report. (TTT)

19813 (REG/G-4.1(1-73)) MEASURING AND REPORTING OF RADIOACTIVITY IN THE ENVIRONS OF NUCLEAR POWER PLANTS. (Directorate of Regulatory Standards (AEC), Washington, D. C.). 18 Jan 1973. 4p. DRS, Washington, D. C.

19814 RADIOACTIVE CONTAMINATION OF THE ENVIRONMENT. Atmosphere, Water, and Food Products. Orbe Murillo, F. (Salazar de Ortega, Magdalena, Ecuador). Politecnica (Quito); 1: No. 3, 75-112(1969). (In Spanish).

Maximum values in pC/m³ for radioactive contamination of the tmosphere at Quito, Ecuador, were as follows: $^{144}Ce-^{144}Pr$, .320; ^{141}Ce-, 0.276; ^{131}I, 0.192; $^{106}Ru-^{106}Rh$, 1.01; and $^{95}Zr-^{95}Nb$, .528. These values were within acceptable limits, as were those or drinking water, milk, and food products. Values from some oastal areas were appreciably higher but still within acceptable limits. (Euratom)

Atmosphere

Refer also to abstracts 19805 and 19809.

315 (BNWL-SA-4460) RADIOLOGICAL SAFETY ASPECTS THE NUCLEAR POWER PROGRAM. Unruh, C. M. (Battelle cific Northwest Labs., Richland, Wash.). Oct 1972. 46p. ONF-721122-2). Dep. NTIS. From Regional Study Group Meeting on Radiological and Environmental Protection; Istanbul, Turkey (20 Nov 1972).

The primary objective of nuclear power plant design is to maintain positive control over all radioactive materials under both normal and abnormal operating conditions. These design features are described and programs for the management of gaseous and liquid wastes are discussed. Criteria for the development and periodic review of environmental monitoring programs are presented. Radiation protection guides and standards developed by the International Commission on Radiological Protection (ICRP) and the National Council on Radiation Protection and Measurements (NCPP) form the basis on which environmental monitoring programs have been developed. (43 references). (CH)

19816 (CNEA-321) RADIOACTIVE FALLOUT ATTRIBUTED TO PACIFIC OCEAN EXPLOSIONS IN THE PERIOD 1966-1970. Beninson, D.; Migliori de Beninson, A.; Menossi, C. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1972. 18p. (In Spanish). Dep. NTIS (U. S. Sales Only).

During the period 1966 through 1970 radioactive fallout from nuclear explosions in the South Pacific were detected in the atmosphere over Argentina. The results of studies made on the environmental radioactivity and on the resulting radiation doses to the human population are summarized. A quantitative evaluation of the passage of ^{131}I from the environment to man was made with special interest in the transport parameter between the fallout and milk. From measurements of the levels of activity of individual radionuclides, the exposure dose for the population from the radiation was determined to be a tenth of a mrad and the dose in thyroids of children was several hundredths of a mrad. The relation between the activity of ^{131}I deposited on the ground and the time integral for the concentration of this nuclide in milk was calculated. (tr-auth)

19817 (COO-3257-4) STUDIES ON COLLOIDAL PARTICLES; SCAVENGING OF AEROSOL PARTICLES BY A FALLING MACROSCOPIC PARTICLE. Annual Progress Report, January 1, 1972-December 31, 1972. Kerker, M. (Clarkson Coll. of Tech., Potsdam, N. Y.). 1972. Contract AT(11-1)-3257. 29p. Dep. NTIS.

Measurements of the collection efficiency of a freely falling water droplet falling through a silver chloride aerosol were carried out. The apparatus was modified to permit preparation of the aerosol in nitrogen rather than helium (in order to simulate air) and to vary the distance over which the droplet accelerates prior to entry into the scavenging chamber from 30 cm up to 515 cm. The effect of particle size was studied. For a 0.158 cm droplet and accelerating distance of 30 cm, particle radius ranged from 0.16 to 0.46 μm. For a 0.254 cm droplet and accelerating distance of 515 cm, particle radius varied from 0.12 to 0.36 μm. The results were correlated with Pêclet number using a newly developed theory assuming potential flow and diffusion through a concentration boundary layer. For a particle radius 0.36 μm, the effect of Reynold's number was studied for droplet radii 0.116, 0.158, and 0.254 cm and for acceleration distances 30 cm, 298 cm, and 515 cm. A very strong dependence upon Reynold's number was observed. These results were extrapolated to give collection efficiencies at terminal velocity for four droplet sizes. With additional results to be obtained during the coming period, calculations will be carried out of the rate of washout of submicron aerosol with rainfall rate as well as the effect upon atmospheric visibility. (auth)

19818 (HASL-269) WORKSHOP ON NATURAL RADIATION ENVIRONMENT (MARCH 1972). McLaughlin, J. E. (ed) (Health and Safety Lab. (AEC), New York). Aug 1972. 80p. Dep. NTIS.

Separate abstracts were prepared on seven papers that discuss various aspects of the contribution of natural background to the radioactivity of the human environment. (CH)

For abstracts of individual papers see: 19819-19823, 19825, and 19826.

19819 (HASL-269, pp 1-7) TIME VARIATIONS OF ENVIRONMENTAL RADIATION. Lowder, W. M. Aug 1972.

In workshop on natural radiation environment (March 1972).

Factors in the environment that are responsible for the more significant variations in levels of radioactivity in the lower atmosphere with time are discussed. It is pointed out that time variations in levels of cosmic radiation are very slight and the only effects that produce changes in the lower atmosphere of more than one percent are related to interplanetary magnetic fields correlated with the 11 year solar activity cycles, and variations in atmospheric pressure and temperature. The two most significant factors influencing changes in γ intensity are the emanation of radon gas from the soil and building materials and its subsequent diffusion and transport, and the deposition of fallout from weapons tests and the subsequent migration of radionuclides through soil. Soil moisture content and snow cover, both related to atmospheric precipitation, are the two attenuating media most subject to change with time. Another source of seasonal change in γ intensity is the development of local vegetation, which produces changes in both source density and attenuating media. (CH)

19820 (HASL-269, pp 39-46) AERIAL SURVEY OF THE NATURAL RADIATION ENVIRONMENT. Burson, Z. G. Aug 1972.

In workshop on natural radiation environment (March 1972).

Since 1958, the Aerial Radiological Measuring System (ARMS) has provided the USAEC a rapid and economic tool for measurement of both natural and man-made radiation distributed over large areas. The ARMS system includes a Twin Bonanza Beechcraft, an array of radiation sensing instrumentation, a flying crew, and scientific backup in the application of this system to a wide variety of radiological measurements. These airborne gamma radiation surveys, flown at altitudes of 300 to 500 feet above the terrain, provide much definitive information about the terrestrial radiation environment, from both natural and man made sources. Other programs have been concerned with measuring the terrestrial dose reduction due to snow cover and ground moisture. The primary use of the terrestrial radiation survey data is: to provide a baseline in case of an accident of any type; to aid in evaluating the impact of nuclear facilities on their environment; and to document on a broad scale the background radiation environment in which we live. Most of the survey data are stored on magnetic tape. This data bank has broad possible uses in geographic time-dependent radiation effects studies. (CH)

19821 (HASL-269, pp 47-56) RADIATION LEVELS INSIDE AND OUTSIDE BUILDINGS. Goldin, A. S. Aug 1972.

In workshop on natural radiation environment (March 1972).

A number of surveys of γ radiation levels inside and outside buildings have been made. Among these are surveys made in Sweden, in the United Kingdom, in East Germany, in Poland, and in the United States. The great variability in radiation levels observed especially in masonry houses, the lack of dependence of exposure rates on height in masonry buildings, and the occasional high dose rates observed in buildings made of materials of high radioactivity content all point to the general conclusion that masonry buildings effectively attenuate the terrestrial radiation from the ground and the surroundings, and that the entire γ radiation dose in such buildings may be attributed to radionuclides in the masonry. Concentrations of radon daughters in the air primarily affect the dose to lung, and even more specifically to some basal cells in bronchial epithelium. The effectiveness of ventilation or air conditioning in reducing this dose is discussed. (20 references) (CH)

19822 (HASL-269, pp 57-59) ENVIRONMENTAL RADIATION FIELDS. Beck, H. L. Aug 1972.

In workshop on natural radiation environment (March 1972).

The environmental measurements program at the USAEC Health and Safety Laboratory (HASL) has always relied on a combination of both experimental and theoretical techniques designed to completely characterize a given external environmental radiation field. Because of the difficulty of measuring quantities such as angular flux and exposure rate distributions and particle flux spectra directly, computer codes were developed to model typical environmental fields and to study the relationship between physical parameters such as soil moisture, soil composition, source geometry, source spectra, etc., on the various physical quantities used to describe the radiation field. The results of these calculations were then used to interpret instrument response, interpret field measurements, predict environmental exposure rates, and relate exposure rates to tissue dose. Similarly, calculated flux spectra and other physical quantities as a function of detector height above the earth-air interface can be used to interpret aerial monitoring data, while data for one meter has served as the foundation for in situ field spectrometric analysis techniques. Applications are described in order to illustrate the utility of carrying out theoretical calculations of physical quantities describing typical natural background environmental radiation fields. (CH)

19823 (HASL-269, pp 60-80) ADEQUACY OF EXISTING INTEGRAL AND DIFFERENTIAL RADIATION AND RADIOACTIVITY MEASUREMENTS AND CALCULATIONS FOR POPULATION DOSE DETERMINATIONS. Wrenn, M. E. Aug 1972.

In workshop on natural radiation environment (March 1972).

Problems presented in the measurement, computation, or calculation of the radiation dose to man from low-dose environmental exposure, and in extrapolation to estimates of doses to human populations at various locations, are discussed. Examples cited include: variations in results of measurements of natural background radiation at the same site during a 12-month period using thermoluminescent measurements or pressurized ion chambers; and variations in environmental radioactivity associated with sampling techniques. (CH)

19824 (HEDL-SA-494) COMPARISON OF THE RADIATION DOSE TO THE GENERAL PUBLIC WITH FENCELINE DOSES AT NUCLEAR FACILITIES. Bentley, B. W. (Westinghouse Hanford Co., Richland, Wash. (USA)). 7 Dec 1972. Contract AT(45-1)-2170. 11p. (CONF-730401-1). Dep. NTIS.

From the 19th Annual Technical Meeting and Equipment Exposition of the Institute of Environmental Sciences; Anaheim, California, United States of America (USA) (1 Apr 1973).

A study was conducted which provides a basis for comparison of the potential radiation exposure at nuclear facility fencelines and the potential radiation dose to the general public in a region with a substantial nuclear power industry. The dose evaluations were made for the anticipated nuclear power industry and population density of 29.1 million estimated in the Upper Mississippi and Lower Missouri River basins in the Year 2000. The study region includes all or a portion of eight midwestern states encompassing 300,000 square miles. An additional 200 mile wide buffer zone around the region was included to assess the contribution to the radiation exposure of the population within the study area from airborne radioactivity from adjacent areas. The estimated average dose rate throughout the region was less than the fenceline dose rate at the nuclear facility sites. Radiation doses region wide and near the sites were estimated to be less than the dose rates from naturally occuring background radiation. (CH)

Soil

19825 (HASL-269, pp 8-11) GEOLOGY AND NATURAL TERRESTRIAL DOSE RATES. Smith, A. R.; Wollenberg, H. A. Aug 1972.

In workshop on natural radiation environment (March 1972).

The natural component of environmental gamma radioactivity measured on land depends mainly on the uranium, thorium, and potassium contents of the rock and soil. Detailed studies of the distribution and abundance of U, Th, and K and associated gamma dose rates in rocks encompassed are summarized. (auth)

19826 (HASL-269, pp 12-38) METHODS FOR THE IN SITU MEASUREMENT OF RADIONUCLIDES IN SOIL. Anspaugh, L. R.; Phelps, P. L.; Huckabay, G. W. Aug 1972.

In workshop on natural radiation environment (March 1972).

The feasibility of using a Ge(Li) detector in the field to quantify radionuclides contained in soil was demonstrated. In addition a generalized computer code was developed for application to a variety of detector geometries and source distributions. Very small differences, i.e., 2% for ^{40}K, were noted in radioactivity levels for the natural occurring radionuclides as measured by the in situ Ge(Li) method and laboratory analysis. The discrepancy in results for ^{137}Cs however was larger and probably was related to inadequate soil sampling over too small an area. Work is presently underway to better understand the problem. (auth)

19827 DISTRIBUTION OF RADIOACTIVE SOIL CONTAMINATION IN HUNGARY. Toeroek, I. (Szilikatipari Koezponti Kutato es Tervezo Intezet, Budapest); Kovacs, J. Izotoptechnika; 16: No. 1, 21-31(Jan 1973). (In Hungarian).

The geographical, meteorological, soil chemical and physical, and agrotechnological factors involved in soil contamination are discussed. Methods of fallout measurement are also discussed and results of measurements are given. (TSS) (auth)

19828 ADSORPTION AND DESORPTION OF ^{60}Co, ^{85}Sr, AND ^{137}Cs ON SOIL HUMIC ACID. Dunigan, E. P.; Francis, C. W. (Louisiana State Univ., Baton Rouge). Soil Sci.; 114: No. 6, 494-496(Dec 1972).

Humic acid was isolated from the top 2.5 cm of the A horizon of an Emory silt loam soil. Preweighed samples of the prepared humic acid were washed twice with 25 ml of normal chloride solutions of Sr, Co, and K, labeled with ^{85}Sr, ^{60}Co, and ^{137}Cs, respectively. Desorption studies were carried out using 4 washings of the humic acid. A strontium-humic acid equilibrium was established slowly. Addition of base increased the amount of Sr adsorbed. The opposite effect was noted with Co and Cs. More than 98% of the ^{85}Sr was removed by washings with salt solutions; 91 to 99% of the ^{60}Co was removed; varied results were obtained for ^{137}Cs. (MCG)

19829 MIGRATION AND DISTRIBUTION OF ^{54}Mn IN THE SOILS OF ARMENIA. Ananyan, V. L.; Mnatsakanyan, B. G. Soobshch. Inst. Agrokhim. Probl. Gidroponiki, Akad. Nauk Arm. SSR; No. 11, 25-30(1971). (In Russian).

In the soils under investigation, ^{54}Mn is characterized by its active mobility compared with other isotopes, such as ^{137}Cs and ^{90}Sr. In the chernozemic, chestnut, and high-mountain meadow soils, ^{54}Mn decreases in quantity according to depth of soil and in 20 to 40 cm it forms 20 to 30% of the total quantity. Both the types of soil and the vertical zonality play no decisive role in the process of the migration of ^{54}Mn. (auth)

19830 MIGRATION OF ^{137}Cs ON VARIOUS SOILS OF ARMENIA. Ananyan, V. L.; Mnatsakanyan, B. G. Soobshch. Inst. Agrokhim. Probl. Gidroponiki, Akad. Nauk Arm. SSR; No. 11, 14-18(1971). (In Russian).

Studies on the migration of ^{137}Cs were carried out on three vertical profiles involving the main soil types of Armenia. It was found that the upper layer (0.5 cm) of different soils of Armenia, ^{137}Cs content represents 65 to 100%. In brown and chestnut soils, migration is greater than in chernozem soils and especially in mountain-meadow soils. Content of ^{137}Cs increases in soils rich with humus. (auth)

19831 CONTENTS OF RADIOSTRONTIUM IN THE MAIN SOILS OF ARMENIA. Ananyan, V. L.; Avetisyan, A. S. Soobshch. Inst. Agrokhim. Probl. Gidroponiki, Akad. Nauk Arm. SSR; No. 11, 19-24(1971). (In Armenian).

The vertical migration of ^{90}Sr in the different soils of Armenia and its proportional contents in the upper layer (0 to 20 cm) of those soils were studied. On arid soils, up to 50 to 80% of the ^{90}Sr is accumulated in the upper layer (0 to 5 cm). Under definite local conditions, ^{90}Sr is mixed and accumulated in lower layers, e.g. 5

to 10 cm, 15 to 25 cm. On arable soils ^{90}Sr penetrates to a depth of up to 113 to 140 cm. In general, the distribution of ^{90}Sr has a zonal feature. However, in the limits of one and the same soil there are some deviations. (auth)

19832 EFFECT OF THE LEVEL OF RELIEF ON THE DISTRIBUTION OF RADIOACTIVE ELEMENTS. Ananyan, V. L.; Mnatsakanyan, B. G. Soobshch. Inst. Agrokhim. Probl. Gidroponiki, Akad. Nauk Arm. SSR; No. 11, 31-35(1971). (In Russian).

The effect of relief on the distribution of natural and artificial radioactive elements on three sub-alpine meadows was investigated. The distribution of ^{137}Cs depends on the relief. As a rule, its content is slight on the steep slopes, while on the lower ones it is relatively higher. The characteristics of the distribution of the total β radioactivity is subject to the same rule, with the difference that the changes are not as distinct as the others. The changes in the potassium contents depending on the level of the slopes are weak, and even decrease in some of them. (auth)

Water

19833 BIOLOGICAL VALUE OF EXISTING LEVELS OF RADIOACTIVE POLLUTION OF THE SEA. Pertsov, L. A.; Prokhorycheva, N. P.; Sokovishin, V. A. Biol. Nauki; No. 7, 64-68(Jul 1972). (In Russian).

A comparison was made of radioactive contamination levels of hydrobionts involving natural and artificial sources of ionizing radiation. Existing levels of radioactive contamination of waters and hydrobionts in the Pacific Ocean are not pathogenic and occur within the limits of radiation valence. (tr-auth)

19834 CONTEMPORARY GEOCHEMISTRY OF RADIOCARBON IN THE GULF OF MEXICO. Mathews, T. D. College Station, TX; Texas A and M Univ. (1972). 125p. University Microfilms Order No. 73-3555.

Thesis (Ph. D.).

A general radiocarbon survey was conducted for the Gulf of Mexico and adjacent areas. A wide variety of samples was run in an effort to determine current levels of radiocarbon activity in Gulf coast rivers, the atmosphere, sedimentary samples, the marine biosphere, and seawater. The survey emphasized the detection of man-made or fallout ^{14}C from the 1961–1962 nuclear weapons tests. Fallout ^{14}C was found in many of the samples, although to varying degrees of enrichment. River water appeared to have average $\Delta^{14}C$ values of about +100‰, but no distinct trends with respect to location or time were evident. It was also found that for the 1970–1971 period atmospheric CO_2 had an average ^{14}C enrichment of about 470‰, although the trend was toward decreasing activity with time due to uptake of $^{14}CO_2$ by the ocean surface and dilution of $^{14}CO_2$ by $^{12}CO_2$ due to the combustion of fossil fuels. Sedimentary samples were from two sources: coral and carbonate cores. The coral, Acropora cervicornis, contained fallout ^{14}C and reflected the ^{14}C content of the surrounding seawater. This indicated a potential use in detecting phenomena changing the radiocarbon content of seawater, such as upwelling. The carbonate coretops from the Campeche slope area, however, contained no bomb ^{14}C, probably because the upper portion of the sediment column had been removed by scouring or slumping. Several biological samples, representing different members of the food chain, were run. Four of the five samples contained fallout ^{14}C in varying amounts. The radiocarbon activity of each sample was explained on the basis of feeding habits and depth in the water column. Seawater samples showed variations in radiocarbon activity with time, location, and depth. Based on seawater radiocarbon data, a simple model was presented for circulation in the western Gulf. The assumptions for the model were that lateral transport from east to west accounted for the renewal of intermediate water and eddy diffusion downward resulted in the renewal of deep water. Using these assumptions, residence times were calculated for the intermediate and deep water in the western Gulf of 20 and 270 years, respectively. (Diss. Abstr. Int., B)

Ecosystems and Food Cycles

Refer also to abstracts 19842 and 20158.

19835 MONITORING THE RADIOACTIVITY OF MILK. Wiechen, A. (Bundesanstalt fuer Milchforschung, Kiel). Ernaehr.-Umsch.; 19: No. 6, 209-212(1972). (In German).

A brief survey is presented of the significance of milk within the framework of environmental radioactivity monitoring (fallout from nuclear explosions, fission products in the reactor environment), the pathway of fission products into milk, measures for reducing contamination, and measured values in the German Federal Republic over the period from 1955 to 1971. (GF)

19836 CESIUM KINETICS IN A MONTANE LAKE ECOSYSTEM. Hakonson, T. E. Fort Collins, CO; Colorado State Univ. (1972). 166p. University Microfilms Order No. 73-2791.

Thesis (Ph. D.).

This study was initiated to determine the kinetics of cesium in East Twin Lake, a 5 hectare, natural semi-drainage lake, which lies at an elevation of 2880 meters in the north-central Colorado Rockies. The lake, which has a 7 meter maximum depth, is characterized by its extensive littoral and emergent zones, emergent vegetation and dyseutrophic appearance. One kilogram of ^{133}Cs was introduced into the water of East Twin Lake on September 15, 1970. Samples of water, seston, sediment, amphipods, zooplankton, trout and three species of vegetation were obtained over a 393 day period following the dosing event. Stable cesium was measured by neutron activation analysis. The loss of ^{133}Cs from water occurred in two phases. The rapid phase, which resulted in the loss of 60% of the cesium from water, had a loss half-time of 0.5 days while the slow phase had a loss half-time of 130 days. The seston fraction of each water sample contained from 25% to 80% of the ^{133}Cs present in each liter of unfiltered water. Bottom sediments were identified as the major site of deposition of the ^{133}Cs dose. The sediment, at 393 days post-dosing, accounted for 82% of the ^{133}Cs inventory in the lake whereas water and seston accounted for only 3 and 14%, respectively. Amphipods and zooplankton reached equilibrium with the water within about three weeks after the ^{133}Cs administration and achieved concentration factors of about 700 and 150, respectively. During mid-winter, however, these organisms showed increased concentrations of ^{133}Cs with concentration factors ranging up to 2800 and 400 for amphipods and zooplankton, respectively. Trout accumulated the ^{133}Cs more slowly than the invertebrates and reached a maximum concentration factor of about 5500 some 260 days following the dosing event. The major parameters governing ^{133}Cs accumulation in trout, namely the ^{133}Cs retention half-time and food intake, were shown to vary greatly throughout the year. The simulation of the kinetics of ^{133}Cs in the East Twin Lake ecosystem was approached by utilizing the observed ingrowth data to solve for the intercompartmental transfer rate constants. The constant coefficient model described the general behavior of the observed data very well. The use of ^{133}Cs as a tracer for ^{137}Cs was both reliable and feasible. Absolute quantities as small as 10^{-8} grams of ^{133}Cs were detectable. Concentrations of ^{133}Cs and fallout ^{137}Cs in trout muscle were significantly correlated which indicated that the kinetic behavior of the isotopes was similar. Furthermore, the stable tracer obviates the radiation protection problems that would arise from contaminating a public water with a radioisotope of cesium. (Diss. Abstr. Int., B)

Radiometric Techniques

Refer also to abstracts 19453, 19802, and 19834.

19837 (EURISOTOP-61) ISOTOPE METHODS IN GROUND WATER SCIENCE. Drost, W.; Moser, H.; Neumaier, F.; Rauert, W. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). May 1972. 183p. (In German). Dep. NTIS (U.S. Sales Only).

A review is given of the possibilities and results of isotope applications in ground water investigations. General methods in the use of isotopes in hydrology are outlined. The application of artificial radioactive tracers, the use of natural isotopes, and combined application of isotope methods are discussed. A bibliography of 324 references is appended. (JSR)

19838 (NYO-1669-1) HELIUM IN THE ATMOSPHERE AND LITHOSPHERE. Annual Progress Report No. 1. Kulp, J. L. (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory). 15 Nov 1954. Contract AT(30-1)-1669. 41p. Dep. NTIS.

A mass spectrometric method was developed for determination of ^{40}Ar in rocks. Topics discussed in the appendixes include: behavior of minute quantities of inert gases in vacuum systems, absorption of primary helium by igneous rocks, excess helium in certain minerals, equilibrium conditions for atmospheric helium, and decay of ^{40}K to ^{40}Ar and ^{40}Ca. (MCG)

19839 (NYO-1669-3) HELIUM AND ARGON IN ROCKS AND MINERALS. Annual Progress Report No. 3. Kulp, J. L.; Damon, P. E. (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory). 1 Jan 1957. Contract AT(30-1)-1669. 39p. Dep. NTIS.

The origin and composition of the "excess" inert gases in various minerals and age estimation by the K–Ar and He methods were studied. (MCG)

19840 (NYO-1669-5) HELIUM AND ARGON IN ROCKS AND MINERALS. Annual Progress Report No. 5. Kulp, J. L.

(Columbia Univ., Palisades, N. Y. Lamont Geological Observatory). 1 Apr 1959. Contract AT(30-1)-1669. 343p. Dep. NTIS.

Age estimations using argon and helium methods are discussed. Reprints and preprints of reports on the work are included. (MCG)

19841 (NYO-7242) INVESTIGATIONS IN ISOTOPIC GEOCHEMISTRY. Annual Progress Report No. 8. Kulp, J. L. (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory). 31 Jan 1963. Contract AT(30-1)-1669. 307p. Dep. NTIS.

Studies on age estimation from isotopic ratios are reported. Reprints and preprints of reports on the work are included. (MCG)

19842 SOIL ZINC AND ITS UPTAKE BY PLANTS. I. Isotopic Exchange Equilibria and the Application of Tracer Techniques. Tiller, K. G.; Honeysett, J. L.; de Vries, M. P. C. (Commonwealth Scientific and Industrial Research Organization, Glen Osmond, Australia). Aust. J. Soil Res.; 10: No. 2, 151-164 (Oct 1972).

Isotopic exchange studies were applied to the laboratory and glasshouse measurement of labile zinc in 25 soils from nine Great Soil Groups. The laboratory equilibration procedures worked well with acidic and most near neutral soils, but may overestimate labile zinc values for the lateritic podzolic soils. The values for some acidic soils were also compromised because of lack of isotopic equilibrium. The laboratory method gave erratic and unrealistic data when applied to alkaline soils due to fixation of the added zinc. The procedures based on the specific activity of zinc absorbed by plants from soils equilibrated with carrier-free ^{65}Zn gave reproducible values of the total amount of plant available zinc for all soils. These values agree well with the corresponding laboratory data for acidic soils. Furthermore, the specific activity data showed that magnesium chloride and EDTA extractions had equilibrated with the same chemical form or forms of zinc as that absorbed by the plants. (auth)

19843 CHOICE OF RADIOISOTOPES AND THEIR ACTIVITY FOR HYDROGEOLOGICAL RESEARCH PURPOSE. Makowski, J. Isotopenpraxis; 8: No. 9, 327-332(Sep 1972). (In German).

Hydrogeological and hydrotechnical researches using radioactive tracer solutions has encountered serious difficulties so far, concerning the choice of adequate radioisotopes to be used in the solution and even much more so to select appropriate values of minimum radioactivity necessary effectively to carry through the researches. The trials now attempted in Poland to arrive at a standard model design for such preliminary investigations are described. Tests were carried out in this model in columns of various lengths, which resulted in finding an experimental equation, expressing in a simple form the changes in concentration of the radioactive tracer solution along with its flow path. The sole exponential coefficient contained in this equation furnishes a characteristic of the sum-total of the dispersion factors, depending in turn on the type of radioisotope used, the character of flow and the physico-chemical properties of soil and water medium. (auth)

19844 GEOCHRONOLOGICAL SIGNIFICANCE OF DISCORDANT U–Pb AGES OF OVAL-SHAPED ZIRCONS FROM A LEWISIAN GNEISS FROM HARRIS, OUTER HEBRIDES. Pidgeon, R. T.; Aftalion, M. (Scottish Research Reactor Centre, East Kilbride). Earth Planet. Sci. Lett.; 17: No. 1, 269-274 (Dec 1972).

Size fractions of oval-shaped zircons from a quartzo-feldspathic gneiss sample from the Lewisian of the Island of Lewis–Harris in the Outer Hebrides have discordant U–Pb isotopic systems. A well-defined chord through the zircon data-points on a concordia plot intersects the concordia at 1715 ± 60 my and 2770 ± 10 my. From comparisons with previous geological and geochronological evidence the lower intersection age of 1715 ± 60 my is interpreted as reflecting an isotopic disturbance concurrent with the Late Laxfordian retrogressive metamorphism and the emplacement of the granite injection complex. The upper intersection age of 2770 ± 10 my is related, in the main, to crystallization of zircon during the major period of gneiss formation. This interpretation is complicated by the presence of a number of zircon cores of possibly igneous origin which suggest a possible component of older lead. As no isotopic evidence for more than one age of original zircon was found it is postulated that the zircon cores were formed only a short time before the onset of high-grade metamorphism. (auth)

19845 CADMIUM CONTENT OF SEA WATER, BOTTOM SEDIMENT, AND FISH, AND ITS ELIMINATION RATE IN FISH. Jaakkola, T.; Takahashi, H.; Soininen, R.; Rissanen, K.; Miettinen, J. K. (Univ. of Helsinki, Finland). pp 69-75 of Radiotracer Studies of Chemical Residues in Food and Agriculture. Vienna; International Atomic Energy Agency (1972).

From Radiotracer Studies of Chemical Residues in Food and Agriculture Meeting; Vienna, Austria (25 Oct 1971). See STI/PUB–332; CONF-711069–.

Cadmium was analyzed in Finnish coastal water, bottom sediment, and fish. Sea water contained in clean areas 0.1 to 0.2 pp 10^9 Cd, in polluted areas 50 to 100 times more. Bottom sediments contained 3 to 10 ppM (clean areas) and 15 to 130 ppM (polluted areas) when calculated on the dry weight of the organic material. Side muscle of pike from clean areas contained 2 to 3 pp 10^9, from contaminated areas 4 to 13 pp 10^9 Cd/fresh wt. Liver contained about 10 times and kidney 50 times more than muscle. These results show only slight pollution. Studies in rainbow trout with ^{115m}Cd showed that oral absorption is only about 1% and the biological half-time is very long. (auth)

19846 ATTENUATION OF γ-RADIATION WIDE BEAM IN SANDY-ARGILLACEOUS GROUNDS. Zvol's'kii, S. T.; Vovk, P. K. (Inst. of Geological Sciences, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 11, 1000-1003(Nov 1972). (In Ukrainian).

Attenuation of the γ radiation wide beam from point sources of ^{137}Cs and ^{60}Co (γ line with energy E_0 = 1.33 MeV) in disperse sandy-argillaceous soils was calculated analytically. Distribution of γ radiation with different scattering multiplicity was studied. With a barrier thickness to 25 g/cm^2 for the cesium source and 40 g/cm^2 for the cobalt one where the primary γ radiation prevails, multiply scattered radiation with the energy E_n < 0.2 MeV, i.e., radiation the scattering of which depends on the medium chemical composition, composes not more than 2% of weakened γ radiation total intensity. In the wide-beam γ method for measuring rock density the multiply scattered radiation may be smoothly cut off by the recorder to providing the required radiation radiometry accuracy. (auth)

Site Surveys

Refer also to abstract 19802.

19847 (CEA-CONF-2158) CREATION OF A LOW FREQUENCY SPECTRUM BY CHEMICAL SHOTS. Leandri, M. (Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre d'Etudes Nucleaires). 1972. 6p. (In French). (CONF-721073-1). Dep. NTIS (U. S. Sales Only).

From Meeting of the organization for economic cooperation and development; Pisa, Italy (3 Oct 1972).

Chemical shots produce movements in the soil of frequencies that are generally greater than those resulting from earthquakes or nuclear explosions. It is not possible to deduce the possible effects of nuclear shots or of earthquakes from the known effects of chemical shots. A method is proposed for obtaining a useable low-frequency spectrum with chemical shots. This method makes use of a shot device arrangement with a planar array of delay antennas, which modifies considerably the initial spectrum of each point explosion and produces an increase of low-frequency amplitudes with respect to those of high frequencies. (tr-auth)

19848 (ORO-4180-3) DYNAMICS AND METHODS INVOLVED IN THE REVEGETATION OF AMCHITKA ISLAND. Progress report, April 1, 1972–January 1, 1973. Amundsen, C. C.; Chilcoat, T. S.; Clebash, E. E. C. (Tennessee Univ., Knoxville). Jan 1973. Contract AT(40-1)-4180. 9p. Dep. NTIS.

The pattern and process of naturally occurring secondary plant succession on Amchitka Island is being studied. Data collected in the summers of 1971 and 1972 are being processed. (MCG)

19849 (UCRL-51192) EARTHQUAKE ANALYSIS OF THE DIAGNOSTIC CHEMISTRY BUILDING, LAWRENCE LIVERMORE LABORATORY. Tokarz, F. J. (California Univ., Livermore. Lawrence Livermore Lab.). 19 May 1972. Contract W-7405-eng-48. 35p. Dep. NTIS.

An investigation of the Diagnostic Chemistry building at Lawrence Livermore Laboratory in Livermore, California was conducted to evaluate its ability to withstand the most critical of several postulated design-basis earthquakes for the Laboratory site. The methods of analysis used and the results obtained are discussed. Also presented are a detailed description of the building; brief discussions of site geology, seismicity, and soil conditions; and the approach used to postulate the design-basis earthquakes. Based on results it is concluded that the main structural system of the building should withstand the ground motions of the postulated design-basis earthquakes without catastrophic failure. However, damage should be expected. The most critical areas are pointed out. (auth)

19850 (UCRL-51193) DESIGN BASIS EARTHQUAKES FOR THE LAWRENCE LIVERMORE LABORATORY SITE. Bernreuter, D. L.; Tokarz, F. J. (California Univ., Livermore. Lawrence Livermore Lab.). 19 May 1972. Contract W-7405-eng-48. 34p. Dep. NTIS.

A thorough review of the geology and past seismic history of the area surrounding the Lawrence Livermore Laboratory site is given. This information is used to identify those active faults on which destructive earthquakes could occur. Earthquake magnitudes are assigned to these postulated earthquakes, and the approaches used to assign magnitudes are discussed. Estimates of maximum possible ground acceleration, response spectra, and duration of the strong shaking at the Laboratory site resulting from the postulated earthquakes are given. A discussion of the methods used to predict these quantities is also presented. Using the foregoing information, design-basis earthquakes, which define the ground motion for Laboratory structural design purposes, are developed. (auth)

19851 REVIEW OF SALT TECTONICS IN RELATION TO THE DISPOSAL OF RADIOACTIVE WASTES IN SALT FORMATIONS. Gera, Ferruccio (Oak Ridge National Lab., TN). Geol. Soc. Amer., Bull.; 83: 3551-3574(Dec 1972).

The plastic deformation of salt formations is reviewed to evaluate the possibility of diapiric processes affecting salt beds used for radioactive waste disposal. In a geological sense, rock salt is characterized by a marked mobility as a result of its ability to deform under relatively low stresses. Examples are known of salt formations deformed by tectonic forces, but the typical diapiric processes are essentially due to gravitational forces. In the initial phase, salt deformation is caused by differential loading of the salt bed; only after salt flowage has resulted in thickening of the low pressure zones of the salt bed does the density difference between salt and sediment contribute to the deforming stress. Salt diapirs are usually large structures, and to furnish the necessary large volume of salt, a mother bed of great initial thickness must be presumed. No minimum depth seems to exist for the plastic deformation of salt; however, the plasticity of salt increases with depth as a result of the increasing temperature. The rate of salt deformation is critical in relation to the required containment time for plutonium-contaminated waste. The geologic literature indicates that most geologists believe salt diapirism to be a relatively slow process and geologic evidence seems to support strongly the majority view. It can be concluded that, in the final stage of salt intrusion, rates of diapir growth as high as a few millimeters per year are possible, and in the initial phase of plastic deformation of the salt bed, flow rates should be markedly lower. In relation to the safety of radioactive waste containment, the risk of excessive deformation can be kept acceptably low if the disposal formation meets the following requirements: (1) bedded salt located in a geologically stable area; (2) subhorizontal salt beds exposed to very limited differential loading; (3) thickness of the salt beds of the order of 100 to 300 m; and (4) depth of the salt beds between 300 and 700 m. (auth)

Thermal Effluents

Refer also to abstracts 19773 and 21733.

19852 (CONF-720451-3) STUDIES OF THE SINKING PLUME PHENOMENON. Hoglund, B.; Spigarelli, S. A. (Argonne National Lab., Ill.). 1972. 23p. Dep. NTIS.

From 15th Conference on Great Lakes Research; Madison, Wisconsin, United States of America (USA) (5 Apr 1972).

The phenomenon of a sinking plume was observed in Lake Michigan during a period of minimum temperature (March and April, 1971) at the site of thermal effluent discharge from the Point Beach Nuclear Power Plant, Two Creeks, Wisconsin. Temperature recorders were placed on the bottom of Lake Michigan near the outfall of the plant. Analysis of the data revealed the warm water did interact with the bottom as long as the lake temperature was 4°C or less. When the ambient temperature exceeded 4°C, there was little indication of temperature perturbations on the bottom as a result of the thermal discharge. The maximum ΔT observed at the nearest thermograph (335 meters) was 5.2°C. The maximum ΔT observed at 1,525 meters from the discharge was 2.6°C. Ambient temperatures at 1,525 meters from the discharge were observed to vary by 2°C. The data are presented in terms of the percentage of time the various instruments were influenced by the thermal plume. Biological implications of the sinking plume with respect to the possibility of premature hatching of fish and insect eggs and with respect to the viability of young fish are discussed. (CH)

19853 (K-P-4023) SOFTENING OF COOLING TOWER BLOWDOWN WATER FOR REUSE. Fowlkes, C. C. (Oak Ridge Gaseous Diffusion Plant, Tenn.). 5 Jan 1973. Contract W-7405-eng-26. 22p. (CONF-730106-1). Dep. NTIS.

From Annual Cooling Tower Institute Meeting; Houston, TX (29 Jan 1973).

The future of chromium- and zinc-based corrosion inhibitors in open recirculating water systems will depend greatly upon the approved disposal procedures for these elements. The State and Federal regulatory bodies are expected to sanction control standards that will negate the use of chromates and zinc without acceptable disposal methods. Future power loads at the Oak Ridge Gaseous Diffusion Plant will make the disposal of chromate and zinc corrosion inhibitors in the blowdown water mandatory. Operational results of recycling and blending the recirculating water blowdown with raw makeup water and softening the mixture are reported. Future plans for softening hot cooling tower blowdown water in a separate treatment plant are also included. (auth)

19854 ANALYSIS OF THE DISPERSION OF THERMAL EFFLUENTS. Mehta, B. M.; Ahlert, R. C. (Rutgers-The State Univ., New Brunswick, NJ). Chem. Eng. Progr., Symp. Ser.; 67: No. 119, 126-133(1971).

Studies were made on a model for the dispersion of thermal discharges in steady open-channel flow. The equation of motion with constant coefficients, representing average turbulent diffusivities, was found to be a poor model of momentum transport in open-channel flow. The equation of motion with variable coefficients was considered qualitatively superior but to lack quantitative accuracy. A rapidly convergent solution of the equation of motion, with variable coefficients, was demonstrated. A model for momentum eddy diffusivities, providing for transport in "core" flow, was found to generate excellent estimates of velocity profiles in open-channel flow. (MCG)

19855 ANALYSES OF HEAT TRANSFER AT COOLING LAKES. Brady, D. K.; Geyer, J. C.; Sculley, J. R. (Johns Hopkins Univ., Baltimore). Chem. Eng. Progr., Symp. Ser.; 67: No. 119, 120-125(1971).

Distinction is drawn between the desired role of dilution in dispersing heat on a global scale, and the undesirable influence of mixing in reducing the efficiency of recirculated cooling lakes. The concept of a cooling lake responding to diurnal fluctuations in equilibrium temperature is presented in terms of an exchange coefficient for converting heat budget components to associated temperature changes. Discrepancies among six currently used empirical evaluations of the windspeed function are discussed, with particular reference to low windspeed conditions. Results of new field studies on a small, mid-Atlantic lake confirm that heat transfer rates remain significant under calm conditions, even when thermal loads are negligible. Use of the design chart for the exchange coefficient, the equilibrium temperature equation, and the exponential decay of excess temperature in an unmixed cooling lake is demonstrated, using the studied mid-Atlantic lake as a sample. (auth)

19856 DISPERSION OF THERMAL DISCHARGES IN BODIES OF WATER. Polk, E. M. Jr.; Benedict, B. A.; Parker, F. L. (Vanderbilt Univ., Nashville). Chem. Eng. Progr., Symp. Ser.; 67: No. 119, 111-119(1971).

The complex problem of describing temperature distributions in waters receiving thermal discharges may be simplified by classifying the distributions in terms of the mechanisms dominating mixing. Analytical models are presented to allow prediction of the temperature regime for three particular distribution classifications: the arrested density wedge; the two and three dimensional diffusion plume; and the heated surface jet. The measured length of warm water wedges in four streams receiving cooling water discharges from power plants is compared to predictions of the wedge length model. It was found that the model compared well to the data provided initial mixing prior to wedge development was accounted for. Water temperature measurements from two additional power plant sites were compared to predictions of the two and three dimensional diffusion models. Lateral diffusion coefficients were found to be greater and vertical diffusions coefficients less than would normally be predicted for mixing of discharges having densities equal to the receiving water. Temperature distributions from three power plant sites are also compared to predictions of a surface jet model, and values of the entrainment and drag coefficients reported. (auth)

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstract 20305.

General Detectors and Monitors

Refer also to abstracts 20472, 20473, 20569, 21015, 21128, and 21486.

19857 (ANCR-1088, pp 347-472) TECHNIQUES AND INSTRUMENTATION. Oct 1972.
In Nuclear Technology Division annual progress report for period ending June 30, 1972.
ACTIVATION ANALYSIS — equipment and methods for neutron, NRTS research on
ANTIMONY-115 — beta and electron-capture decay of, gamma spectrum from, (E)
ANTIMONY-116 — beta and electron-capture decay of ground-state and isomeric, gamma spectrum from, (E)
ANTIMONY-117 — beta and electron-capture decay of, gamma spectrum from, (E)
ANTIMONY-118 — beta and electron-capture decay of, gamma spectrum from, (E)
ANTIMONY-124 — beta decay of, gamma spectrum from, (E)
BARIUM-140 — preparation and standardization of gamma sources of
BROMINE-82 — beta decay of, gamma spectrum from, (E)
CALUTRONS — operation and performance of electromagnetic mass separator at NRTS
CESIUM-132 — beta and electron-capture decay of, gamma spectrum from, (E)
CESIUM-138 — beta decay of, gamma spectrum from, (E)
CHROMIUM-48 — electron-capture decay of, gamma spectrum from, (E)
COBALT-55 — beta and electron-capture decay of, gamma spectrum from, (E)
COBALT-56 — beta and electron-capture decay of, gamma spectrum from, (E)
COBALT-58 — beta and electron-capture decay of, gamma spectrum from, (E)
COMPUTERS — research at NRTS
GALLIUM-66 — beta and electron-capture decay of, gamma spectrum from, (E)
GAMMA SPECTROSCOPY — research progress on, at NRTS
GOLD-193 — electron-capture decay of, gamma spectrum from, (E)
GOLD-194 — beta and electron-capture decay of, gamma spectrum from, (E)
HAFNIUM-180 — decay of isomeric, gamma spectrum from electromagnetic, (E)
IRON-52 — beta and electron-capture decay of, gamma spectrum from, (E)
KRYPTON-85 — beta decay of isomeric, gamma spectrum from, (E)
KRYPTON-87 — beta decay of, gamma spectrum from, (E)
KRYPTON-88 — beta decay of, gamma spectrum from, (E)
LANTHANUM-140 — beta decay of, gamma spectrum from, (E)
MANGANESE-52 — beta decay of isomeric, gamma spectrum from, (E)
— beta and electron-capture decay of, gamma spectrum from, (E)
NEUTRON CROSS SECTIONS — evaluation of, development of ACSAP program for automated
NICKEL-56 — electron-capture decay of, gamma spectrum from, (E)
NICKEL-59 — development of x-ray sources of, for fluorescence analysis
NIOBIUM-96 — beta decay of, gamma spectrum from, (E)
PLATINUM-188 — electron-capture decay of, gamma spectrum from, (E)
PLATINUM-191 — electron-capture decay of, gamma spectrum from, (E)
RAD DET, ACTIVATION — self-shielding effects in in-core neutron flux spectra monitoring
RAD DET, SEMICONDUCTOR (GERMANIUM) — efficiency of Ge(Li), for gamma detection
RUBIDIUM-84 — beta and electron-capture decay of, gamma spectrum from, (E)
RUBIDIUM-88 — beta decay of, gamma spectrum from, (E)
RUBIDIUM-89 — beta decay of, gamma spectrum from, (E)
RUTHENIUM-106 — beta decay of, gamma spectrum from, (E)
SILVER-110 — beta decay of isomeric, gamma spectrum from, (E)
TANTALUM-182 — beta decay of, gamma spectrum from, (E)
XENON-135 — beta decay of, gamma spectrum from, (E)
XENON-138 — beta decay of, gamma spectrum from, (E)
ZINC-72 — beta decay of, gamma spectrum from, (E)

19858 (CERN-73-4) HIGH ACCURACY, TWO-DIMENSIONAL READ OUT IN MULTIWIRE PROPORTIONAL CHAMBERS. Charpak, G.; Sauli, F. (European Organization for Nuclear Research, Geneva (Switzerland)). 14 Feb 1973. 10p. Dep. NTIS (U. S. Sales Only).
A method of allowing the localization, with a very high accuracy, of the position of avalanches in an MWPC is described. The accuracy is of the order of $\sigma = 150$ μm and has so far been shown to be limited only by the electronics. For small chambers of the order of 10 cm, as required for applications as x-ray crystallography, moderately simple systems based on the method can be envisaged. Although at this stage it does not pretend to be more accurate or more simple than the other existing methods, it may be preferable in some cases, e.g., when non-delayed analogue information is needed, giving the position of a particle with the highest precision. (auth)

19859 (FEI-290) ELECTRONIC INSTRUMENTATION FOR EXPERIMENTS ON MEASURING THE RATIO OF CAPTURE CROSS SECTIONS TO FISSION CROSS SECTIONS FOR ^{239}Pu AND ^{235}U WITHIN THE REGION OF FAST NEUTRONS. Poletaev, E. D.; Kononov, V. N.; Bokhovko, M. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1971. 31p. (In Russian). INIS.
The instrumentation is described for measuring the ratio of capture-to-fission cross sections for ^{239}Pu and ^{235}U using a Van de Graaff pulse accelerator. Measurements of α by time-of-flight were also conducted in the energy range 10 to 100 keV. The time resolution of the system was 11 nsec. A 400 liter tank was used as the liquid scintillation detector of the events of capture and fission. The system included a AI-4096-3 multichannel analyzer. (tr-auth)

19860 (INS-TH-75) PRELIMINARY TEST ON A SMALL-SIZE MULTIWIRE PROPORTIONAL CHAMBER. Watanabe, K.; Fujii, T.; Kondo, K.; Yamamoto, A. (Tokyo Univ. (Japan). Inst. for Nuclear Study). 1 Jun 1972. 17p. NTIS (U. S. Sales Only).
Multiwire proportional chambers have become one of the most promising particle detectors in high-energy physics because of their advantages of high spatial resolution and fast time resolution. Recently, a small test chamber was fabricated to study the effects of gas composition, space, and time resolutions. Dimensions of effective surface of the chamber was 108×90 mm^2, and gap length between electrodes 6 mm. The positive electrode consisted of 33 μm gold plated tungsten wires with 3 mm spacing. The gas mixture used was PR gas, but in the future Ar + isobutane and Ar + butane will be tested. In a gate triggering test using ^{90}Sr as a source, there was ~10% spurious triggerings due to accidental coincidence among triggering scintillation counters. Full width half maximum of time jitter is 50 ns, and 99% of the signal falls in 150 ns. (JA)

19861 (JINR-P13-6859) AUTOMATIZATION OF THE PROCESSES OF READING OF WORKING PARAMETERS FROM SCINTILLATION COUNTERS IN MULTICHANNEL SYSTEMS. Petrov, A. G.; Shcherbakov, Yu. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 14p. (In Russian). Dep. NTIS (U. S. Sales Only).
A system is described used for automatization of the process of reading of the curves of delayed coincidences (CDC) and working characteristics on voltage (plato) for a group of scintillation counters. The system allows one to control the feeding voltage for photomultiplier and electronic schemes with the help of a digital voltmeter. Information output to the analyzer AI-4096 is provided. Measurement time in one channel depends on the accuracy required and in most practical cases does not exceed 30 sec. The system is performed in VISHNYA standard. (auth)

19862 LOW-BACKGROUND BETA COUNTER. Gyoenyoer, B. (Technical Univ., Budapest). Period. Polytech. Elec. Eng.; 16: No. 2, 99-112(1972).
Small amounts of activities can be measured by low-background counters. Design and operation of a low-background beta counter is described. The working principle of the transistorized anti-coincidence unit of this counter is discussed in detail and illus-

trated by oscillograms. A background of 1.07 ± 0.1 cpm has been measured. (auth)

19863 ANALYSIS OF CONTINUOUS FLOW ACTIVATED SYSTEMS WITH NON-INSTANTANEOUS MIXING. Scott, M. C.; Atta, M. A. (Univ. of Birmingham, Eng.). Nucl. Instrum. Methods; 106: No. 3, 465-469(1973).

The effect of non-instantaneous mixing in continuous flow systems used for neutron yield determination is examined. A model is developed to take into account the fact that the activity of the sample pumped to the counting chamber may differ from the average activity, and experimental tests of the model are described for both steady and time-varying sources. (auth)

19864 IMPROVED FLEXIBLE DETECTOR CRYOSTAT. Franke, H. F. (Univ., Erlangen, Ger.). Nucl. Instrum. Methods; 106: No. 3, 569-571(1973).

An improved flexible cryostat for a Ge(Li) detector is described. (auth)

19865 PULSE-MATCHING METHOD FOR ESTIMATING THE GAS AMPLIFICATION FACTOR IN PROPORTIONAL COUNTERS. Hendricks, R. W. (Oak Ridge National Lab., TN). Nucl. Instrum. Methods; 106: No. 3, 579-588(1973).

The gas amplification factor in a proportional counter may be estimated by a comparison technique using an oscilloscope. A known capacitor is put in parallel with the input from the detector at the first group of the preamplifier and a unipolar output signal is generated by applying a voltage step from a precision pulse generator. This signal is then matched on the oscilloscope to a similar signal from the main amplifier as created by a monoenergetic x-ray pulse falling on the counter. To obtain the correct value for the gas amplification factor, the differences in rise-times between the charge input from the detector and the pulse generator must be taken into consideration. This correction is obtained from a calibration chart determined from a computer solution of the differential equations which describe the pulse shapes for the pulse generator and the proportional counter at various points in the preamplifier/amplifier system. The calculations assume (1) zero electron collection time in the detector, (2) a charge-sensitive low-noise preamplifier, and (3) a main amplifier having simple RC pulse-shaping networks. The errors introduced by a spread in the electron collection time are discussed. Experimental results which test and illustrate the use of the method are given. (auth)

19866 SCINTILLATION CHAMBER: A HIGH EFFICIENCY DETECTOR INSENSITIVE TO SOURCE DISPLACEMENTS. Bruninx, E. (Phillips Research Labs., Eindhoven, Netherlands). Nucl. Instrum. Methods; 106: No. 3, 613-614(1973).

The geometry, relative pulse height spectra, and the response of a scintillation counter insensitive to source displacements are described. (auth)

19867 DECAY CONSTANT OF CsI(Na) SCINTILLATORS. Yarmon, A.; Ben-Zeev, D.; Inbar, D. (Elscint Ltd., Haifa, Israel). Nucl. Instrum. Methods; 106: No. 3, 615-616(1973).

The decay constant of CsI(Na) scintillation crystals was measured using a sampling technique. A fast exponential decay of 0.928 ± 0.015 μs was observed. (auth)

19868 IMPROVED SCINTILLATION PROBE FOR CONTINUOUS COUNTING OF EXPIRATORY $^{14}CO_2$-GAS. Suzuki, S.; Aoyagi, T.; Fujihira, E.; (and others) (Research Inst. of Tuberculosis, Tokyo). Nucl. Instrum. Methods; 106: No. 3, 539-547(1973).

The combination of an expiratory CO_2 flow system and a scintillation counting system is described for the continuous counting of respiratory $^{14}CO_2$ exhaled from a mouse. Respiratory H_2O is trapped by a cooling trap to eliminate quenching effects of water on the counting. Dried air with expiratory $^{14}CO_2$-gas is fed to a given volume of the hyamine scintillation fluid in the reservoir and is bubbled in the fluid to trap $^{14}CO_2$-gas. A portion of the radioactive scintillation fluid is fed into a scintillation probe and returned to the reservoir continuously by connecting the reservoir and the probe with fine teflon tube. In the probe, the tube is coiled and placed between opposing photomultiplier tubes. The probe is connected with 2 ratemeters following a recorder for continuous counting of radioactivity in the flow stream. This device is particularly suited for the continuous counting of expiratory $^{14}CO_2$ with high counting efficiency as well as that of a liquid scintillation counter. The expiratory $^{14}CO_2$ patterns did not vary with the date, if the same mouse was used during 10.00 a.m. to 1.00 p.m. The patterns of different mice also were almost concordant. Discussions are described in detail for the comparison of respiratory $^{14}CO_2$ patterns given by this device and the other counters. (auth)

19869 ALPHA SURVEY METER (17 Aug 1971) (Engineering Materials). (California Univ., Livermore. Lawrence Livermore Lab.). (CAPE-2281).

48 drawings.

19870 INFLUENCE OF THERMAL EFFECTS ON THE TRACK REGISTRATION CHARACTERISTICS OF PLASTICS. Somogyi, G. (Magyar Tudomanyos Akademia Atommag Kutato Intezete, Debrecen, Hungary). Radiat. Eff.; 16: No. 3-4, 245-251 (Oct 1972).

Thermal effects can alter the physical and chemical parameters of the latent tracks and bulk material of dielectric track recorders, and consequently those of the etched track pits too. A few characteristics of this thermal track-fading effect are studied in various plastic track detectors irradiated with lightly and heavily ionizing nuclear particles. Experimental data are given for the influence of different annealing conditions on the diameter of etch pits and the bulk etch rate of plastics. The possibilities of the eradication of alpha-particle background and the selective thermal track discrimination in cellulose nitrate, cellulose acetate, and polycarbonate detectors are studied. A few practical applications of the thermal track fading are also presented. (auth)

19871 EFFECT OF OZONE ATMOSPHERE ON THE DETECTING PROPERTIES OF PLASTIC TRACK RECORDERS. Somogyi, G. (Magyar Tudomanyos Akademia Atommag Kutato Intezete, Debrecen, Hungary). Radiat. Eff.; 16: No. 3-4, 233-243(Oct 1972).

The influence of ozone-containing atmosphere on the track-etching parameters of cellulose nitrate, cellulose acetate, polycarbonate, and polyvinyl chloride sheets was studied. Evidence of the increase of registration sensitivity was found for all plastics investigated. The effects of ozone treatment on the tracks of both lightly and heavily ionizing nuclear particles are discussed. Experimental data are given on the variations of the etching properties of bulk material and latent tracks as a function of storage times in ozone atmosphere. The observations indicate that in any effect where there is a possibility of ozone production (e.g., with plastic detectors placed in spark discharge or exposed to ultraviolet radiation) the sensitivity variation due to ozone effect cannot be neglected. (auth)

19872 EFFICIENT SPARK CHAMBER DETECTOR FOR ANNIHILATION RADIATION. Chatterjee, T. K.; Draper, L.; Howells, M. R.; Osmon, P. E. (London Univ.). J. Phys., E (London); 6: No. 2, 135-137(Feb 1973).

The use of a spark chamber to extend the standard two-slit positron annihilation method for studying solids has been discussed previously (Howells and Osmon. J. Phys. E. Sci. Instrum.: 4; 929-35 (1971)). The present paper describes a significant development of the γ ray detecting spark chamber used in the above work. The new chamber has plates made of lead foil built into a special laminate to give rigidity but negligible superfluous mass. Efficiency has been gained over the previous design by a factor of 3. The mode of operation should lead to an improvement in the accuracy with which the sparks locate the position of the incident γ ray. (auth)

19873 REMARKS ON FISSION-TRACK DATING IN DIELECTRIC SOLIDS. Somogyi, G.; Nagy, M. (Magyar Tudomanyos Akademia Atommag Kutato Intezete, Debrecen, Hungary). Radiat. Eff.; 16: No. 3-4, 223-231(Oct 1972).

Some factors (long etching and annealing effects) are experimentally and theoretically studied, neglect of which has resulted in low ages in the fission track datings of geological samples. The empirical correction methods, proposed by Storzer and Wagner (Earth Planet. Sci. Letters; 5:463 (1969)) concerning these factors, are reinvestigated. It is shown that these corrections can also be calculated theoretically. The problem is considered in fuller detail for glass samples. A new method is proposed for the correction of the thermally reduced fission-track ages of glasses. The same method involves also the possibility of differentiating the fossil tracks from the spontaneous fission of uranium and superheavy nuclei in the case of fragments entering the glasses at arbitrary angles. (auth)

19874 ENERGY CALIBRATION OF A LIQUID SCINTILLATION COUNTER. Horrocks, D. L. (Beckman Instruments, Inc., Fullerton, CA). Int. J. Appl. Radiat. Isotop.; 24: No. 1, 49-51(Jan 1973).

Since it is possible to count widely different energy ranges on a single scintillation counter, it is desirable to have a method of calibrating the various pulse height ranges. The advantages of using a ^{113}Sn-^{113m}In source for this type of calibration are given. It decays by mono-energetic events and the energy range covered is that required for ^{3}H, ^{14}C, and ^{32}P work. The method of sample preparation and the types of radiation produced are considered in

detail. A typical differential pulse height spectrum for a ^{113}Sn-^{113m}In source dissolved in liquid scintillation cocktail is shown. It is considered that the use of this source should be a considerable aid in setting up discriminator values in defining counting channels and in checking the response of the amplifier system. (UK)

19875 MONTE CARLO CALCULATIONS OF EFFICIENCY VALUES FOR WELL-TYPE NaI-DETECTORS WITH SELF-ABSORPTION IN THE SOURCE. Holmberg, P.; Rieppo, R. (Oulu Univ., Finland). Int. J. Appl. Radiat. Isotop.; 24: No. 2, 99-105(Feb 1973).

Photopeak efficiency values have been calculated for well-type NaI-detectors measuring 2 in. × 2 in. and 3 in. × 3 in. (well ϕ 28.57 mm, depth 38.1 mm) and 4 in. × 4 in. (well ϕ 20.0 mm, depth 39.0 mm). Extended sources in the well were considered in addition to self-absorption in the source material. Sources consisting of water and compact bone were investigated in connection with NaI-detectors measuring 1¾ in. × 2 in. (well ϕ 17 mm, depth 39.5 mm) and 2 in. × 2 in. (well ϕ 20.0 mm, depth 39.5 mm). (auth)

19876 MEASUREMENT OF ATMOSPHERIC ^{35}S USING THE GEL-SCINTILLATOR METHOD. Hofmann, H.; Roedel, W. (Univ., Heidelberg). Int. J. Appl. Radiat. Isotop.; 24: No. 1, 37-45(Jan 1973). (In German).

In order to find the best conditions for measuring the radioactivity of atmospheric sulphur by homogeneous or heterogeneous scintillation counting, the quenching effects of several appropriate inorganic sulphur compounds have been studied. External radiation was used for this purpose. Furthermore, the dependence of counting efficiency for ^{35}S upon light yield was investigated and suitable correction methods are discussed. The counting background influences strongly the counting sensitivity of the apparatus because of the very low specific radioactivity of atmospheric sulphur. The different components of this background are discussed in detail. (auth)

19877 IODIDE ACTIVATED THALLIUM CHLORIDE SCINTILLATOR. Hofstadter, R.; Kramer, G. R.; Farukhi, M. R.; Rosette, K. H. (to Kewanee Oil Co.). U. S. Patent 3,714,057. 30 Jan 1973. Filed date 12 Nov 1969. 6p.

A new high Z scintillator capable of generating light radiation upon exposure to nuclear radiation such as gamma rays, beta rays, protons, mesons, x rays, etc., is described. The scintillator is transparent to light radiation and consists of a major amount of thallium chloride and a minor amount of an iodide containing compound. (Official Gazette)

19878 MEASUREMENT OF FISSION NEUTRON MULTIPLICITIES USING A LARGE VOLUME Gd FILLED SCINTILLATOR. Ribrag, M.; Poitou, J.; Matuszek, J.; Signarbieux, C. (CEN de Saclay, Gif-sur-Yvette, France). Rev. Phys. Appl.; 7: No. 3, 197-203(Sep 1972). (In French).

A large liquid scintillator filled with Gd, used at Saclay in fission neutron multiplicity experiments is presented. An original procedure is described for optimizing the regulation of the detector system and its associated electronics, thus minimizing the possible systematic errors. Several types of error and their appropriate corrections are treated in detail. The results obtained for the spontaneous fission of ^{252}Cf are compared with data obtained by other workers. (FR)

19879 EFFICIENCY OF Ge(Li) THIN WINDOW DETECTORS NEAR ABSORPTION EDGE OF GERMANIUM. Forcinal, G. (RTC-La Radiotechnique-Compelec, Caen, France). Nucl. Instrum. Methods; 107: No. 1, 125-129(15 Feb 1973).

The properties of Ge(Li) thin window detectors have been studied in the energy range 10 to 20 keV. After description of dead layer and escape effects, attention is given to the thinnest window achieved with classical technology. Influence of escape probability of X-rays is then measured with calibrated source and X-ray tube excitation, with energies as close as possible to the absorption edge of germanium. The results obtained are in good agreement with Axel's calculations and indicate that the maximum value of the efficiency attainable at 11.2 keV is 80%. (auth)

19880 NEW INVESTIGATIONS INTO THE DETECTION PROPERTIES OF HYBRID CHAMBERS. Boehmer, V. (Univ., Karlsruhe, Ger.). Nucl. Instrum. Methods; 107: No. 1, 157-163 (15 Feb 1973).

Hybrid chambers are gas-discharge detectors for localization of particle tracks. They consist of a two-electrode proportional chamber and a conventional spark chamber in the same gas space. The influence of mechanical and electric parameters upon the time resolution, the useful trigger delay and the maximum detection efficiency are discussed. Moreover, studies of these detection characteristics as a function of various gas fillings and quenching gas fractions are reported. (auth)

19881 APPLICATION OF THE ^{90m}Y-DECAY FOR PEAK EFFICIENCY CALIBRATION OF Ge(Li)-DETECTORS. Hanser, A. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Instrum. Methods; 107: No. 1, 187-188(15 Feb 1973).

The intensity ratio of the 480–203 keV gamma-ray cascade of ^{90m}Y is determined as 1.072 ± 0.004. This allows an accurate peak efficiency calibration of Ge(Li)-detectors at 203 keV. (auth)

19882 NEW METHOD OF DETERMINING THE COMPTON EDGE IN LIQUID SCINTILLATORS. Chikkur, G. C.; Umakantha, N. (Karnatak Univ., Dharwar, India). Nucl. Instrum. Methods; 107: No. 1, 201-202(15 Feb 1973).

A new method is suggested for determining more accurately the Compton edge in the pulse height distribution of liquid scintillators. (auth)

19883 ^{169}Y AND ^{110m}Ag AS EFFICIENCY CALIBRATION STANDARDS FOR Ge(Li) DETECTORS. Lavi, N. (Soreq Nuclear Research Centre, Yavne, Israel). Nucl. Instrum. Methods; 107: No. 1, 197-198(15 Feb 1973).

Accurately measured energies and relative intensities of the gamma- and x-rays emitted in the decay of ^{169}Yb and ^{110m}Ag are recommended for use as calibration standards for Ge(Li) detectors. (auth)

19884 BAYESIAN STATISTICS APPLIED TO THE OPTIMAL ESTIMATION OF BACKGROUND IN ROUTINE NUCLEAR COUNTING PROCEDURES. Raeside, D. E. (Mankato State Coll., MN). Nucl. Instrum. Methods; 107: No. 1, 5-8(15 Feb 1973).

Bayesian estimation theory is applied to the problem of determining a best estimate of the background count rate in routine counting procedures. The optimal estimation procedure is carried out using a practical loss function and a conjugate prior probability distribution. The Bayes estimate is obtained by using data, prior information and tabulated values of the chi-square probability function. (auth)

19885 FAST ZERO-TIME DETECTOR FOR HEAVY IONS USING THE CHANNEL ELECTRON MULTIPLIER. Pfeffer, W.; Kohlmeyer, B.; Schneider, W.F.W. (Univ., Marburg, Ger.). Nucl. Instrum. Methods; 107: No. 1, 121-124(15 Feb 1973).

Channel electron multipliers were used for detection of secondary electrons ejected from a thin foil by heavy ions. The properties of this system have been investigated with ions up to iodine. A time resolution of 350 ps and high efficiency in connection with small dimensions and uncritical operation make it to be an appropriate zero-time detector in a time-of-flight telescope for heavy nuclei. (auth)

19886 SHORT HALF-LIFE MEASUREMENTS USING A PAIR OF SEMICONDUCTOR DETECTORS. Bishop, R. J. (Kingston Polytechnic, Kingston upon Thames, Eng.). Nucl. Instrum. Methods; 107: No. 1, 9-11(15 Feb 1973).

A Ge(Li) detector and a surface barrier detector have been operated in coincidence to measure the half-life of the 59.6 keV excited state of ^{237}Np, yielding a result of 70 ± 3 ns. (auth)

19887 THERMAL NEUTRON FLUX MEASUREMENT AT VERY HIGH TEMPERATURE USING IRIDIUM. Lavi, N. (Soreq Nuclear Research Centre, Yavne, Israel). Nucl. Instrum. Methods; 107: No. 1, 13-14(15 Feb 1973).

The feasibility of applying iridum for thermal neutron flux measurement at very high temperature was investigated experimentally. The thermal neutron flux was calculated from the absolute activity of ^{194}Ir measured with a 60 cm^3 Ge(Li) detector. Good results were obtained at temperatures in the region of 1800°C. (auth)

Radiation Dosimeters

Refer also to abstracts 19818, 19826, 20076, 20090, 20091, and 20093–20095.

19888 (CLOR-91/D) PREPARATION OF RADIOPHOTOLUMINESCENT GLASSES FOR INDIVIDUAL DOSIMETRY PURPOSES. Wolska Witer, M.; Koczynski, A.; Wilgocki, M. (Centralne Laboratorium Ochrony Radiologicznej, Warsaw (Poland)). 1972. 27p. (In Polish). Dep. NTIS (U. S. Sales Only).

The preparation and properties of silver-doped phosphate glass for gamma photoluminescent dosimetry are described. Individual dosemeters measuring 8 × 8 × 4.7 mm were found to measure gamma doses of 0.2 to 1000 R with an accuracy of ±10%. (auth)

19889 (EUR-4904) SEMINAR ON POSSIBILITY OF USE OF EXOELECTRON EMISSION IN DOSIMETRY, BRUNSWICK, JUNE 12-13, 1972. Eriskat, H.; Seguin, H. (eds.) (European Atomic Energy Society, Paris (France)). 1972. 187p. (In several languages). Dep. NTIS (U. S. Sales Only). EUR FB 250.-.

Twenty papers are presented. Thermally-stimulated exoelectron emission properties of various materials including BeO, CaF_2, ZnO, and V_2O_5 are discussed. Also, optically-stimulated exoelectron emission properties and thermoluminescent properties of some of these materials were studied. Various readout equipment and procedures are described, and the application of stimulated exoelectron emission to age estimation is briefly discussed. (WHK)

19890 (HASL-260) HIGH PRESSURE ARGON IONIZATION CHAMBER SYSTEMS FOR THE MEASUREMENT OF ENVIRONMENTAL RADIATION EXPOSURE RATES. DeCampo, J. A.; Beck, H. L.; Raft, P. D. (New York Operations Office (AEC), N. Y. Health and Safety Lab.). Dec 1972. 73p. Dep. NTIS.

High pressure argon-filled steel-walled ionization chamber systems for the measurement of environmental radiation have been developed and field tested. Calculated chamber responses as a function of gamma-ray energy and wall thickness verified by laboratory measurements with gamma-ray sources. The cosmic-ray response was also investigated both theoretically and experimentally. Devices for measuring the ionization current are described, as well as instrumentation systems actually used in the field for determining environmental exposure rates in several types of radiation fields of different varying spectral energy distributions. (auth)

19891 (JAERI-M-4886) MANUAL OF GAMMA-RAY DOSIMETRY USING AN IONIZATION CHAMBER. Okada, M. (Japan Atomic Energy Research Inst., Tokyo). Jul 1972. 13p. (In Japanese).

Included in the manual are the following items: principle in the method of measurement, structure of a spherical ion chamber, method of ion-current measurement, experiment on the saturation characteristics in an ion chamber, measurement of ion current by means of charge accumulation, experiment on relation between dose rate and ion current, activity measurement of ^{60}Co and ^{137}Cs sources, and calibration of a GM-type survey meter. (auth)

19892 (ORNL-4811, pp 62-73) APPLIED DOSIMETRY RESEARCH. Becker, Klaus; Cheka, J. S.; Crase, K. W.; Gammage, R. B.; Lee, M. H.; Nagpal, J. S.; Sohrabi, M. Sep 1972.

In Health Physics Division annual progress report for period ending July 31, 1972.

Topics include the role and nature of activators in thermally-stimulated exoelectron emission (TSEE); TSEE reader development; reproducibility and stability of TSEE detectors; atmospheric, temperature, and other effects on TSEE; fading stability of solid-state (dielectric track, photoluminescent, and thermoluminescent) and film dosimeters; thermoluminescence dosimetry; and track etching of dielectric track detectors for fast neutron personnel dosimetry. (WHK)

19893 DOSIMETRY OF IONIZING RADIATIONS USING TINTED LAVSAN AND CELLOPHANE. Kobalenko, L. M.; Gaichenko, L. N.; Lavrentovich, Ya. I.; Kabakchi, A. M. This paper was summarized in At. Energ. (USSR); 31: No. 5, 510(Nov 1971) as paper No. 540/6230. (In Russian).

Full copy of this paper is held by TIC.

Dosimetric properties of ten industrial films produced from Lavsan and cellophane, tinted in different colors by organic dyes, were investigated. The films were subjected to ^{60}Co γ-radiation, electrons (0.23 MeV), deuterons (13 MeV), and α-particles (23 MeV). The amount of linear energy loss was varied from 0.2 to 30 keV/μ, the strength of the dose from 1 to 100 krad/sec, and the temperature from 30 to 100°C. As a result of the irradiation a discoloration of the films was observed; degree of discoloration measured at the maxima of the absorption of the dyes was proportional to the absorbed dose. From the tinted films of Lavsan only for the dark green, red, and turquoise color the dependence of the degree of discoloration of the dyes on the dose has a linear character. Dark-green films of Lavsan are most sensitive to irradiation in the wavelength range near 450 nm. The dependence of discoloration of cellophane films on the dose is close to linear; the red films are more sensitive to irradiation than yellow films. A change in the dose strength and the temperature does not have any effect on the nature of discoloration of films on irradiation in the investigated ranges. The optical density of both irradiated and nonirradiated films does not change during the storage of the films for a year under ordinary conditions. Scattered daylight has no effect on the optical properties of the samples. (TFD)

19894 DOSE RATE DOSIMETER CIRCUIT. Erickson, G. L. (to United States Atomic Energy Commission). U.S. Patent 3,702,936. 14 Nov 1972. Filed date 19 Mar 1971. 6p.

The circuit uses the ionization characteristics of a Geiger-Mueller tube to provide equal energy charging pulses for an integrator. The integrator voltage is compared with a reference voltage to develop an alarm signal when the integrator voltage exceeds a preset level. Both the integrator and the circuit developing the reference voltage are connected to the same power supply so that power supply fluctuations have a minimum effect on the radiation level at which the alarm operates. A single variable resistance can be used to change the ranges over which the dosimeter operates. (Official Gazette)

19895 EXOELECTRON EMISSION DOSIMETRY. Oberhofer, M. Euro-Spectra; 11: No. 4, 110-116(Dec 1972).

A dosimetric method, based on exoelectron emission (Kramer effect), is described. Particular attention is devoted to the mechanism of exoelectron emission, exoelectron detection, the dosimetric properties of various materials and dosimeter design. (EU)

19896 THERMOLUMINESCENCE INDUCED IN CONCRETE FOR GAMMA DOSIMETRY IN CASE OF NUCLEAR ACCIDENT. De Franceschi, L.; Gentili, A.; Sabbatini, V. (Centro Applicazioni Militari Energia Nucleare, S. Piero a Grado, Italy). Health Phys.; 24: No. 3, 287-291(Mar 1973).

The thermoluminescence of concrete was found to offer an inexpensive and simple technique for estimating the gamma dose associated with a nuclear accident. The useful range of the fine component of concrete (that which passes through 180 mesh screen) is between 30 and 2×10^4 R when pre-annealed 10 min at 100°C and read using a heating cycle of 200°C in 30 s. Maximum fading rate observed was 5%/day with an energy dependence similar to Al_2O_3 or SiO_2. The TL characteristics, glow-curves, fading, sensitivity, reproducibility, energy response, linearity and sample preparation of concrete are discussed. (UK)

19897 FIFTY-CHANNEL DOSIMETER WITH SEMICONDUCTOR DETECTOR. Denisenko, O. N.; Il'ichev, B. V.; Kozlov, V. A.: V. A.; Skoropad, Yu. D.; Striokov, M. E. (Inst. of Medical Radiology, Obninsk, USSR). Med. Radiol.; 18: No. 2, 40-45(Feb 1972). (In Russian).

A skeleton diagram of the 50-channel dosimeter with semiconductor detectors designed for measuring dose fields in static methods of irradiation is described. (auth)

19898 ABSOLUTE SILICON-DOSE CALORIMETER. Murray, K. M. (Naval Research Lab., Washington, DC). Nucl. Instrum. Methods; 107: No. 1, 109-113(15 Feb 1973).

An adiabatic calorimeter to measure absorbed dose in silicon due to 14 MeV x-rays is described. Design criteria leading to a simple, small and accurate instrument are discussed. Details of the fabrication and the performance of the instrument are presented. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 19800, 21057, 21082, and 21116.

19899 (EGG-1183-1530) INTEGRATED REFLECTANCE MEASUREMENTS OF SEVERAL SHA AND RAP CRYSTALS. Storey, W. H. (EG and G, Inc., Las Vegas, Nev.). Sep 1971. Contract AT(29-1)-1183. 23p. Dep. NTIS.

Several crystals each of two types, RAP and SHA, have been calibrated for use in fixed-energy Bragg spectrometers for the low-energy region (1.487 to 3.337 keV). A pulsed electron beam (3 to 210 ns pulse width, 210 sec^{-1} repetition rate) on a copper anode was employed, which required the development of a specialized system for data acquisition and reduction. This system is described, as is a computational procedure for applying the calibration results to measurements of a continuous x-ray spectrum. (auth)

19900 (IAE-2169) TERNARY CORRELATIONS IN PROCESSES FOLLOWING β DECAY OF NUCLEI. Lyul'ka, V. A. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 12p. (In Russian). INIS.

Long-term stability characteristics of a spectrometer were assured by autostabilization systems. The quality of operation of such systems depends, to a great degree, on the stability of the amplitude and form of the standard signal developed by the precise amplitude generators. Precise amplitude generators were assembled, based on a transistorized chopper of constant voltage with independent supply and control circuits. A highly stable gating circuit is described which was built around this same transistorized chopper. (tr-auth)

19901 (JINR-P10-6817) EPOS PROGRAM FOR SPECTRUM PROCESSING. BLOCK DIAGRAM. Eler, G.; Gopych, P. M.; Vinel, G. V.; Khabenikht, V.; Vylova, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 14p. (In Russian). Dep. NTIS (U. S. Sales Only).

A fast program for γ-spectrum processing was constructed based on the statistical fitting method suggested by Oehler. The program is written in ALGOL-60 language for computer BESM-4 and is characterized by the high rate (by 1 to 2 orders higher than the available programs have) and automation of operation. (auth)

19902 (JINR-P13-6830) USE OF SILICON DETECTORS IN β PARTICLE SPECTRUM MEASUREMENTS. Beregi, E.; Bylov, Ts.; Kratsikova, I.; Li Chen Son; Osipenko, B. P.; Permyakova, L. A.; Tishin, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 12p. (In Russian). Dep. NTIS (U. S. Sales Only).

The peculiarities of using silicon detectors, when measuring the β-particle spectra, are considered. A special magnet device is used, if necessary, for discrimination of background radiation accompanying β-particles. The energy resolution of 2.2 keV is obtained for the energy of 80 keV (K 121–^{152}Eu). (auth)

19903 (ORNL-4811, pp 82-5) SPECTROMETRY RESEARCH AND DEVELOPMENT. Thorngate, J. H.; Auxier, J. A.; Kerr, G. D.; Perdue, P. T.; Abd-El Razek, M. M. Sep 1972.

In Health Physics Division annual progress report for period ending July 31, 1972.

Topics include the development of a ^{6}Li glass scintillation neutron detector for the ARMS system, gallium arsenide phosphide diode light pulser for calibrating photomultipliers, contributions to environmental impact statements, development of a high-sensitivity NE-213 scintillator fast neutron spectrometer, distribution of charged particle stopping, zone refining of organic compunds, and the natural radiation environment and man's influence on it. (WHK)

19904 GENERATOR FOR TESTING HIGH RESOLUTION NUCLEAR SPECTROSCOPY INSTRUMENTATION. Galotzy, J.; Bayer, R.; Nadachowski, M. (Inst. of Nuclear Research, Swierk, Poland). Nukleonika; 17: No. 7/8, 411-415(1972).

A sliding and precision pulse generator that provides pulses at regular and random rates is described. It stimulates a broad range of nuclear detector pulses–rectangular or exponentially decaying with adjustable rise and fall times. The generator has the specifications required for testing integral and differential linearity, stability and resolution of instruments employed in high resolution spectroscopy. A differential nonlinearity ±0.3% is obtained within 95% of full amplitude range. The operation principle and typical applications of the generator are briefly described. The specifications and some results of measurements are given. (auth)

19905 NEW THREE-STATE MASS SPECTROMETER FOR HIGH ABUNDANCE SENSITIVITY MEASUREMENTS. Smith, D. H.; Christie, W. H.; McKown, H. S.; Walker, R. L.; Hertel, G. R. (Oak Ridge National Lab., TN). J. Mass Spectrom. Ion Phys.; 10: No. 3, 343-51(Jan 1973).

A three-stage mass spectrometer has been constructed consisting of two magnetic stages of 30-cm radius followed by an electrostatic analyzer with a radius of 43.25 cm. The instrument gives an abundance sensitivity of better than 1×10^{7} and is used primarily for the isotopic analysis of uranium. (auth)

19906 NEUTRON SPECTRA ESTIMATION FROM PROTON RECOIL DATA. Mutone, G. A.; Meyer, W. (Kansas State Univ., Manhattan). Nucl. Instrum. Methods; 106: No. 3, 445-452(1973).

A method to unfold neutron spectra from experimental proton recoil data in the form of a Multi-Channel Pulse Height Analyzer Histogram is developed and tested. Since the energy spectrum of a neutron source is essentially the probability density function of the energy with which neutrons are emitted, the theory of random variables is used to develop the basic unfolding method. Time series analysis and Fourier analysis is subsequently applied to obtain smooth estimates of the neutron spectra. The method is tested by its application to experimental data produced with an NE-213 fast neutron spectrometer system and a Benjamin-type spectrometer system. Spectra of neutron sources such as Pu–Be and ^{252}Cf are unfolded. The spectral estimates are compared with calculations, published data and results obtained with other unfolding methods. (auth)

19907 RESOLUTION FUNCTION OF A HYBRID NEUTRON SPECTROMETER. Steinsvoll, O. (Institutt for Atomenergi, Kjeller, Norway). Nucl. Instrum. Methods; 106: No. 3, 453-459 (1973).

A hybrid neutron spectrometer is described. It consists of a crystal monochromator unit and a time-of-flight analyzer unit. The chopping of the beam can be performed either by using a curved slit rotating chopper or by means of a so-called "flipper-chopper" device. The resolution function of the spectrometer is formulated using the independent resolution-vector approach. Experimentally obtained resolution ellipses are compared with the results of computer calculations. By means of a diagonalization procedure the computer programs can also give the lengths and orientations of the principal axes of the resolution ellipsoid for any experimental geometry. This is of great help in planning neutron inelastic scattering experiments. (auth)

19908 DEPENDENCE OF THE INTEGRATED INTENSITY OF A SCATTERED NEUTRON GROUP ON THE EXPERIMENTAL CONDITIONS. Dolling, G.; Sears, V. F. (Chalk River Nuclear Labs., Ont.). Nucl. Instrum. Methods; 106: No. 3, 419-428(1973).

The accurate determination of phonon or magnon dispersion relations by neutron inelastic scattering with a triple-axis crystal spectrometer is facilitated by choosing scanning modes which give sharply focused scattered neutron groups. Since the optimum scanning mode is in general not a constant-Q mode, the integrated intensity of a group should be corrected for its dependence on the scanning mode before being used to determine, for example, the polarization vector of the phonon or magnon. The necessary correction factor is derived and compared with experiment for a number of cases of practical interest. (auth)

19909 METHOD FOR DETERMINATION OF PEAK POSITIONS IN RADIATION SPECTRA. Kajfosz, Josef (Inst. of Nuclear Research, Rez, Czech.). Jad. Energ.; 19: No. 1, 22-24(Jan 1973). (In Czech.).

The present method permits preliminary determination of peak positions and amplitudes to be used as first guess values in conventional least-squares fitting procedures. (auth)

19910 LIQUID SCINTILLATION SPECTROMETRY SYSTEM FOR SAMPLE ANALYSIS. Thomas, E. W.; Rapkin, E. (to Intertechnique SA). U. S. Patent 3,715,586. 6 Feb 1973. Filed date 5 Feb 1968. 10p.

A liquid scintillation spectrometer system including several discriminator channels and a single amplification chain consisting of several pre-adjusted linear amplifiers providing, for example, three pre-adjusted ranges in the gain ratios of 1, 10, 100 is described. Thus ^{32}P can be counted in a channel with a gain of 1 and tritium can be counted in a channel with a gain of 100. A range switch proceeds each pulse height analyzer permitting any isotope to be counted in any channel. In an alternative system, similar in principle, signals are taken from several dynodes of the photomultipliers, for example the ninth dynodes, the 11th dynodes, and the 13th dynodes. (12 claims, 6 drawing figures) (Official Gazette)

19911 NEUTRON ENERGY DISTRIBUTION FROM Am–Be DETERMINED BY A TIME OF FLIGHT TECHNIQUE. Lutkin, J. E.; McBeth, G. W. (Brighton Polytechnic, Eng.). Nucl. Instrum. Methods; 107: No. 1, 165-171(15 Feb 1973).

The neutron energy distribution from a 3 Ci Am–Be source was measured using a double scatter time-of-flight technique. The spectrum was in general agreement with previous determinations. No evidence for the existence of a low energy neutron excess was obtained. (auth)

19912 HIGH RESOLUTION LEAD GLASS CHERENKOV γ-SPECTROMETER. Astvatsaturov, R. B.; Ivanov, V. I.; Khachaturyan, M. N.; Kramarenko, V. A.; Kulakov, B. A.; Malakhov, A. I.; Meikumov, G. L. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instrum. Methods; 107: No. 1, 105-107(15 Feb 1973).

Pb glass Cherenkov γ-spectrometers of new configuration were tested using an electron beam. The data on the energy resolution for electron energies of 2 and 4 GeV (7.2% and 5.1% respectively) and also on the discrimination power against hadronic background are presented. (auth)

19913 LOW ENERGY POSITRON SPECTROMETER. Patrick, J. R.; Rupaal, A. S.; Spanel, L. E. (Western Washington State Coll., Bellingham). Nucl. Instrum. Methods; 107: No. 1, 1-3 (15 Feb 1973).

The design and operation of a low-energy (0 to 100 eV) cylindrical electrostatic positron spectrometer is described. The spectrometer was calibrated with electrons from a heated tungsten coil. Its energy resolution was measured to be 7%. Preliminary results for the negative work function of positrons from gold are presented and discussed. (auth)

19914 FOCUSING CRYSTAL SPECTROMETER AT FRIBOURG UNIVERSITY. Piller, O.; Beer, W.; Kern, J. (Univ., Fribourg, Switzerland). Nucl. Instrum. Methods; 107: No. 1, 61-77(15 Feb 1973). (In German).

The construction of a DuMond-type curved crystal spectrometer is described. The apparatus is designed to operate with a fixed source. The crystal and collimator are rotated by independent precision gears driven by stepmotors. One step corresponds to a

crystal rotation of 0.3''. A magnetostrictive driving mechanism allows interpolation between steps. The complete spectrometer is enclosed in a thermostatic hut. The reproducibility of a measurement within a two day period is shown to be better than 0.1''. The nonlinearity of the system has been calibrated with a Wild T3 theodolite and a Moore table with a precision better than 0.2''. The measurements of many transitions in the decays of ^{182}W and ^{198}Hg in several orders and the application of the energy combination principle allow a very good test of the performances. They have shown that the precision has not been over-estimated. As a practical result a new more precise set of energies for the transitions in ^{182}W below 264 keV are given with reference to the W $K_{\alpha 1}$ and Hg-411, 794 keV standards. (auth)

19915 BENDING DEVICE FOR FOCUSING CRYSTAL SPECTROMETER. Beer, W.; Piller, O.; Kern, J. (Univ., Fribourg, Switzerland). Nucl. Instrum. Methods.; 107: No. 1, 79-83 (15 Feb 1973). (In German).

A pendulum system to fabricate, usually within two to four hours, a pair of blocks to curve crystal plates by the imprisonment method was constructed. After grinding, the obtained average precision is ±1 μm. The final polishing takes only a few minutes. A modified design of the Sumbaev system, which presents the double advantage of smaller surface pressure and easier and more precise construction is proposed. The curvature of the crystal was controlled by means of a Michelson interferometer. A transverse curvature has become evident, which does not affect the resolution of the spectrometer. (auth)

19916 PERMANENT MAGNET BETA-RAY BAND-SPECTROGRAPH WITH 75 CM MAXIMUM RADIUS. Illes, F.; Berenyi, D.; Schadek, J. (Inst. of Nuclear Research, Debrecen, Hungary). Nucl. Instrum. Methods; 107: No. 1, 93-97(15 Feb 1973).

A permanent magnet beta-spectrograph of special type with a maximum curvature radius of 75 cm was built, in which only a limited radius band from 60 to 75 cm can be used with the goal to study the different internal conversion phenomena of radioactive nuclear transitions, mainly on the higher atomic shells and subshells. The best resolution obtained is 0.04% with a wire source of 0.02 cm in diameter. (auth)

High Energy Physics Instrumentation

Refer also to abstract 20532.

19917 (AD-749865) GROUND-BASED COSMIC-RAY INSTRUMENTATION CATALOG. Shea, M. A. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 17 Jul 1972. 323p. (AFCRL-72-411; AFCRL-AFSIG-243). NTIS.

A comprehensive listing of ground-based cosmic-ray detectors in operation from 1932 through 1971 has been assembled and the pertinent information and data availability of each sensor is given. The cosmic-ray instrumentation cataloged consists of neutron monitors, muon detectors and ionization chambers. (auth)

19918 (BNL-17587) SOME COMMENTS ON THE 80" BEAM 4 OPERATION. Maschke, A. W. (Brookhaven National Lab., Upton, N. Y.). 31 Jan 1973. 3p. Dep. NTIS.

The original motivation for investigating the solo operation of the 80-in. bubble chamber was to save on electricity. Many other advantages to running in this mode are also discussed. (auth)

19919 (IFVE-SEF-71-89) SELECTION OF ELECTRONS IN SECONDARY PARTICLE BEAMS WITH MOMENTUM UP TO 50 GeV/c AND DETECTION OF ELECTRON SHOWERS. Kachanov, V. A.; Kut'in, V. M.; Lapshin, V. G.; Rykalin, V. I.; Semenov, V. K. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 22p. (In Russian). INIS.

The use of a Cherenkov cutoff counter with high resolution for separating electrons in beams of secondary particles is described. Data on the electron output and other investigations on the electron beam are given. Measurements of the electron resolution of a lead-scintillation sandwich were made in the energy range to 50 GeV/c. The dimensions of electron showers were evaluated with a scintillation hodoscope based on a hodoscopic photomultiplier. (tr-auth)

19920 (IFVE-SEF-71-121) CONTROL SYSTEM FOR TAKING PHOTOGRAPHS FROM THE BUBBLE CHAMBER SKAT. Mikhailov, O. I.; Rybakov, V. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 22p. (In Russian). INIS.

A control system for a film transport mechanism of a photochamber is described. The system includes a source of illumination for reference marking and digital information, and a control circuit for photographing in the SKAT bubble chamber. The principal circuits are described. (tr-auth)

19921 (IFVE-SPK-71-75) SKAT-TYPE PROPANE-FREON BUBBLE CHAMBER (A PROJECT). Barabashev, A. Z.; Gerdyukov, L. N.; Danil'chenko, I. A.; (and others) (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 48p. (In Russian). INIS.

The propane-Freon bubble chamber project SKAT with a photographic volume of 4500 × 1300 × 1100 mm^3 is described. Photographing of the chamber is done with four cameras through a 2.5 m film of water that fills the shield volume and through a sliding glass 140 mm thick. The entire volume of the chamber is photographed. 27 flashbulbs placed in the special illuminator are used for illumination. The pressure is varied by one diaphragm with 25 valves with a transfer cross section of 120 mm. A magnet with a field strength of 25 to 27 kG with a power drain of 8.4 to 14 MW was developed for the chamber. (tr-auth)

19922 (JINR-P13-6691) STREAMER CHAMBER FILLED WITH ^{3}He. Korolev, V. M.; Kulyukin, M. M.; Lyashenko, V. I.; Pontekorvo, D.; Piradzhino, G.; Falomkin, I. V.; Shcherbakov, Yu. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 7p. (In Russian). Dep. NTIS (U. S. Sales Only).

The streamer chamber filled with ^{3}He at elevated pressure for use at the Joint Institute for Nuclear Research.is described. The chamber was exposed to a pion beam at 100 MeV. 200,000 pictures were taken to study the process of π^3He inelastic scattering. (auth)

19923 (RI-72-7) OPTICAL DISTORTION OF THE GARGAMELLE BUBBLE CHAMBER. Pascaud, C.; Heusse, P.; Vialle, J. P. (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire). Oct 1972. 24p. (In French). Dep. NTIS (U. S. Sales Only).

The grid measurements made on the optical bank of CERN were used to determine the distortions of the Gargamelle optics. The results are tabulated. The positions of the camera with respect to the chamber system and the positions of the fiduciary crosses of the film press in the film plan were determined. The measurement error was determined. (JSR)

19924 MEASUREMENT OF THE SPATIAL COORDINATES OF HIGH ENERGY PHOTONS WITH A SCINTILLATION HODOSCOPE SPECTROMETER. Bushnin, Yu. B.; Klimenko, S. V.; Krasnokutskii, R. N.; (and others) (Inst. for High Energy Physics, Serpukhov, USSR). Nucl. Instrum. Methods; 106: No. 3, 493-498 (1973).

A scintillation counter hodoscope was used to study the characteristics of electromagnetic showers with energies up to 40 GeV. The energy release in the shower is found to decrease exponentially with distance from the axis of the shower and to be localized within a radius of 1 cm. The position of the photon at the face of a scintillation counter hodoscope spectrometer can be determined with an accuracy of a few millimeters, using the center of gravity of the amplitudes from the counters. (auth)

19925 SIMPLE SYSTEM PRODUCING A 450 kV PULSE WITH 1 ns RISE TIME. Eggert, K. (Technische Hochschule, Aachen). Nucl. Instrum. Methods; 106: No. 3, 509-512(1973).

A simple pulse shaping network is described. It consists of a capacitor connected in series with a sparkgap. A Marx generator feeds the system. Calculations of the equivalent circuit reproduce the behavior of the pulseformer, which generates a pulse of 450 kV with 1 ns risetime and 7 ns fwhm on a load of 80 Ω. With such a system streamer chambers can be driven quite conveniently. (auth)

19926 UNIVERSAL WIRE DETECTOR CAMAC SCANNER. Nunamaker, T. A. (Univ. of Chicago). Nucl. Instrum. Methods; 106: No. 3, 557-561(1973).

The scanning system described provides for the complete digital readout of wire spark chambers of the "Shift Register" capacity readout type, the magnetostrictive types, and the MWPC's with shift register data output. The scanner is a self contained CAMAC module with its own 64 word by 16 bit buffer memory. Two test modes are incorporated for automatic checking. For the complete checkout of the over 1000 bits of memory in the scanner, a CAMAC Test module serves as a memory exerciser and tester. Cabling to the wire chambers is very simple, merely a single cable, making the data retrieval from arrays of many chambers a straightforward task. (auth)

19927 TRACK FORMATION IN A LIQUID HYDROGEN ULTRASONIC BUBBLE CHAMBER. Brown, R. C. A.; Hilke, H. J.; Jarman, P. D. (CERN, Geneva). Nucl. Instrum. Methods; 106: No. 3, 573-577(1973).

Track sensitivity to minimum ionizing particles has been demonstrated in liquid hydrogen using only an intense ultrasonic field. Carefully designed transducer systems are shown to be capable of producing pressure amplitudes >2.8 atm in a standing wave system in liquid hydrogen. The growth of bubbles to visible size (0.1 mm) in less than 0.2 ms, and their collapse in less than 15 ms, indicates that rapid cycling rates of 50 to 100 pulses per second may be feasible with this technique. (auth)

19928 PATTERN RECOGNITION PROCESSOR AND ITS APPLICATION TO STRAIGHT LINE RECONSTRUCTION OF SPARK CHAMBER DATA. Solomon, J. (Univ. of Illinois, Chicago); Nunamaker, T. A. Nucl. Instrum. Methods; 107: No. 1, 15-20(15 Feb 1973).

A general purpose hardware processor is described for use in conjunction with a digital computer to speed up reconstruction of straight line tracks from data generated in wire spark chamber experiments. The processor receives both data and operating instructions from the computer. With a 50 ns cycle time it executes a search algorithm which simultaneously tests many possible combinations of data. It quickly sorts out the points that are likely candidates for straight lines; the computer makes the final decision. One hundred spark chamber events taken at the Argonne National Laboratory were analyzed using a pure software approach and compared with an analysis using responses from the Pattern Recognition Processor as simulated by a separate program. For equivalent operations the latter performed approximately four times as fast. The expectation that the Pattern Recognition Processor will do even better as the complexity of the events increases is discussed. (auth)

19929 LIVE TARGET PERFORMANCES IN COHERENT PRODUCTION EXPERIMENT. Bellini, G.; Di Corato, M.; Manfredi, P. F.; Vegni, G. (Istituto Nazionale de Fisica Nucleare, Milan). Nucl. Instrum. Methods; 107: No. 1, 85-92(15 Feb 1973).

A telescope of five totally depleted silicon detectors has been used as "live" target in a coherent production experiment. The interaction investigated was: $\pi^- + Si \rightarrow \pi^+ + \pi^- + \pi^- + Si$, with a 16 GeV/c π^--beam. The electrical signals from the detectors were amplified by independent pulse processing electronic chains and, once digitized, were recorded on a magnetic tape. The charged fast secondaries of the interaction were detected by a magnetic spark chamber system. The coherent events were separated from the incoherent background by requiring that the recoil energy, measured directly from the target, be consistent with the energy obtained from the kinematical analysis of the interaction, based on fast secondaries measurements. A good reduction of the incoherent background results mainly in the region of the first and the second diffraction maximum. (auth)

19930 APPARATUS FOR SCANNING OF BUBBLE CHAMBER PHOTOGRAPHS. Gill, P. S.; Prasad, J.; Garg, P. K. (Central Scientific Instruments Organization, Chandigarh, India). Nucl. Instrum. Methods; 107: No. 1, 115-120(15 Feb 1973).

The design, construction, and salient features of a bubble chamber scanner are given. The apparatus is arranged as a triple projector with three identical film feeding units and associated systems. The negatives are projected onto a horizontal white screen at 10× magnification for examination. (TFD)

19931 PERFORMANCE OF THE SLAC 2-METER STREAMER CHAMBER IN A STUDY OF MULTIBODY PHOTOPRODUCTION. Fries, D. C.; Davier, M.; Derado, I.; Liu, F. F.; Mozley, R. F.; Odian, A. C.; Park, J.; Swanson, W. P.; Villa, F.; Yount, D. (Stanford Univ., CA). Nucl. Instrum. Methods; 107: No. 1, 141-155(15 Feb 1973).

The performance of the SLAC 2-m streamer chamber is evaluated using the results of a high-statistics, multibody-photoproduction experiment carried out with an 18 GeV bremsstrahlung beam. The instrumental arrangement is outlined, and the data-analysis procedures are described in detail. Special methods are then discussed for dealing with trigger, dip-angle, and hydrogen-target losses and for weighting the surviving events. Finally, the spatial resolution, instrumental efficiency, and overall normalization accuracy are given, and the momentum range over which particle types can be distinguished by ionization is discussed. The results of this evaluation indicate that the streamer chamber is successful in combining the high geometrical resolution, excellent multiple-track efficiency, nearly 4π solid angle, and ionization capabilities of the bubble chamber with the high repetition rate and triggering facility of the spark chamber. (auth)

19932 OPERATION OF A TRACK SENSITIVE HYDROGEN TARGET IN A 500 l NEON HYDROGEN BUBBLE CHAMBER. Ayres, J. F. (Rutherford High Energy Lab., Chilton, Eng.); Coleman, T. G.; Damerell, A. R.; Fisher, C. M.; Fitzharris, E. W.; Foster, J. H.; Gottfeldt, P.; Mack, B.; Mortimer, A. R.; Seager, P.; Stokoe, J. R.; Williams, P. R.; Leutz, H.; Tischhauser, J.; Wenninger, H. Nucl. Instrum. Methods; 107: No. 1, 131-140(15 Feb 1973).

A 20 l hydrogen filled track sensitive target has been successfully operated in the 1.5 m cryogenic bubble chamber at The Rutherford High Energy Laboratory. The chamber was filled with a mixture of neon and hydrogen at a concentration of 45 mol% neon giving a radiation length of 860 mm. Satisfactory track quality in both target and chamber was achieved and 65,000 pictures have been obtained in a 4 GeV/c π^+ beam. (auth)

Radiometric Instruments

19933 (ANCR-1088, pp 341-6) RESEARCH AND DEVELOPMENT FOR NONREACTOR RELATED DISCIPLINES. Oct 1972.

In Nuclear Technology Division annual progress report for period ending June 30, 1972.

DENSIMETERS—development of telemetered network of gamma radiometric, for snow profiles

ELECTRON PROBE MICROANALYSIS—data analysis for Si(Li) detector, development of on-line method for

19934 (BARC-625) RADIOISOTOPE SMOKE ALARM (RISA). Krishnamurthy, K.; Rao, S. M.; Ramakrishna, G. S.; Deshpande, R. S.; Raskina, A. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 14p. Dep. NTIS (U.S. Sales Only).

A radioisotope smoke alarm device for use in early fire warning systems is described. The unit consists of a suitable tritium source-ion chamber assembly with associated electronics. The unit possesses high sensitivity for smoke detection. Its reliability and radiological safety were also studied. (auth)

19935 (EURISOTOP-10) RADIOMETRIC LEVEL GAUGING IN THE PRODUCTION OF MINERAL WOOL. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). Aug 1971. 19p. (In French). Dep. NTIS (U. S. Sales Only).

In the fabrication of mineral wool, the regular functioning of the installation and the quality of the product are determined by the output of threads, which vary as a function of the level of the mass in the preparation vats. Controlling this level during the fabrication is therefore important. A radioisotopic device for the measurement of the filling level is described. The economics and use of this device are discussed. (tr-auth)

19936 (EURISOTOP-37) MEASURING CHARGE LEVEL IN CUPOLA FURNACES USING RADIOISOTOPES. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). Mar 1971. 18p. (In French). Dep. NTIS (U. S. Sales Only).

More than half the cupola furnaces presently in service in foundries are equipped with radiometric apparatus for the measurement of the height of the charge or with automatic charging devices controlled radiometrically. The reason is less in the possibility of an economy of personnel than in that of an improvement of the hygiene for the personnel and in the fact that the radiometric procedure assures a better consistency of the quality of the iron. The use of the radiometric procedure in an installation with one furnace or with two furnaces operating alternately is discussed. (tr-auth)

19937 (EURISOTOP-46) RADIOMETRIC FILLING LEVEL MEASUREMENT IN THE PRODUCTION OF LOW-PRESSURE POLYETHYLENE. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). May 1970. 16p. (In German). Dep. NTIS (U. S. Sales Only).

The radiometric method described gives a sufficiently accurate non-interferring measurement of the filling level in the reaction vessel used in the production of low-pressure polyethylene. Simultaneously it makes possible estimation of the solids slowly formed on the walls of the polymerization vessel. The filling level is determined by two independent measurement devices placed 90° apart. The radiation source is ^{60}Co and G-M counters are used as the detecting device. Technical and economic aspects of the use of radioactive sources are considered. (JSR)

19938 (EURISOTOP-47) RADIOACTIVE FILLING LEVEL MEASUREMENT IN THE PRODUCTION OF HIGH-PRESSURE POLYETHYLENE. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). Aug 1970. 20p. (In German). Dep. NTIS (U. S. Sales Only).

The method for the production of high-pressure polyethylene is outlined and the necessity of filling level measurement in the high-pressure production separator is shown. Specifications for a device for filling level measurements are given. Filling level mea-

surement and control using radioisotopes is then described. The start-up and maintenance of the measurement device are discussed. The radiation source used is ^{60}Co. (JSR)

19939 (EURISOTOP-48) RADIOMETRIC FILLING LEVEL MEASUREMENT AND CONTROL IN VERTICAL ENCLOSURES FOR CONTINUOUS CASTING OF STEEL. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). Aug 1970. 23p. (In German). Dep. NTIS (U. S. Sales Only).

The radiometric measurement and control of the filling level in a continuous casting installation avoids the direct visual observation of the ingot mold. Conventional measurement and control methods, visual methods and measurement with thermoelements, are described. The measurement with a ^{60}Co source and a scintillation counter is described. The technical and economic aspects of the radiometric method are compared with conventional methods. (JSR)

19940 (EURISOTOP-49) RADIOACTIVE FILLING LEVEL MEASUREMENT IN THE PREPARATION OF ACETALDEHYDE. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). Aug 1970. 14p. (In German). Dep. NTIS (U. S. Sales Only).

The method for the preparation of acetaldehyde is outlined and the necessity for filling level measurements is shown. Filling level measurements by conventional methods are discussed. The filling level measurement with radioactive sources of ^{60}Co is then described. Technical and economic aspects of the isotope application are discussed. Radiation protection precautions are outlined. (JSR)

19941 (EURISOTOP-50) CONTROL OF WEIGHT PER UNIT AREA IN THE PAPER INDUSTRY WITH THE HELP OF β EMITTERS (ABSORPTION METHOD). Petrozzi, E. E. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). Apr 1972. 27p. (In German). Dep. NTIS (U. S. Sales Only).

The necessity for the measurement and control of the surface weight, or weight per unit area, in the paper industry is outlined and non-radiometric methods are discussed. The physical bases, attenuation of the β radiation, statistical scattering, sensitivity, radiation decay, sources of error, and detectors and electronics are described. Types of industrial devices for the measurement in the longitudinal direction, measurement in the longitudinal and transverse directions, and profile measurements are described. A technical-economic evaluation of the radiometric methods is made. (JSR)

19942 (EURISOTOP-52) CONTINUOUS ASH DETERMINATION AND CONTROL FOR BITUMINOUS COAL USING RADIOISOTOPES. Mehrhoff, F. W. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). Dec 1971. 25p. (In German). Dep. NTIS (U. S. Sales Only).

The growth of the coal industry is outlined and the processing of fine coal is described. Conventional methods used for the determination of the ash content are described. An automatic method for determining the ash content using ^{241}Am was developed. The sampler, the screw press, the measurement tube, and the measurement device are described. An economic and technical comparison is made of the conventional methods and the radiometric method. (JSR)

19943 (EURISOTOP-56) RADIOMETRIC CONTROL OF THE PACKING OF EARTHWORKS IN DAM AND ROAD CONSTRUCTION. Dreiheller, H. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). Dec 1971. 35p. (In German). Dep. NTIS (U.S. Sales Only).

Classical methods for the determination of soil density and moisture content are described. The principle of the radiometric puncture probes and the depth probes is based on the absorption and scattering of γ radiation by the soil. An economic comparison is made of the classical and radiometric methods. Additional radiometric measurement methods briefly described include the double-tube probes, surface probes, and moisture measurement with fast neutrons. (JSR)

19944 (EURISOTOP-60) MOISTURE MEASUREMENT IN THE PROCESSING OF CERAMIC RAW MATERIALS. Dreiheller, H. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). Jan 1972. 21p. (In German). Dep. NTIS (U. S. Sales Only).

The accurate measurement and control of the moisture content in the production of ceramic products is necessary for quality control. The classical methods used for moisture control are outlined. The principles and operation of a method for the continuous control of the moisture content of the raw materials using neutrons are described. The radiometric method is evaluated economically. (JSR)

19945 (EURISOTOP-64) CONTINUOUS ZINC COATING THICKNESS MEASUREMENT IN BELT GALVANIZING PLANT WITH RADIOISOTOPES. Carl, W. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). May 1972. 22p. (In German). Dep. NTIS (U. S. Sales Only).

Two methods are described for the continuous measurement in galvanizing plants of the thickness of the zinc coatings. The first measures the back scattering of beta beams and the second uses the x-ray fluorescent method. A technical and economic comparison is made of the two methods. (JSR)

19946 (EURISOTOP-66) CONTINUOUS MEASUREMENT OF THE MOISTURE IN WOOD SHAVINGS WITH THE HELP OF NEUTRONS. Koch, E. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). Jan 1972. 24p. (In German). Dep. NTIS (U.S. Sales Only).

A paper and pulp installation is briefly described, and the necessity for moisture measurements is shown. Classical methods for this measurement are described. The problems encountered in the moisture measurement with neutrons are summarized. The neutron device developed for the measurement of the moisture content and the dry weight determination of the wood shavings are described. The device developed uses both a neutron source and a γ source. (JSR)

19947 (EURISOTOP-67) GROUND MOISTURE MEASUREMENT IN AGRICULTURE. Dreiheller, H. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). May 1972. 36p. (In German). Dep. NTIS (U. S. Sales Only).

Classical methods for moisture determination in soils are described. Radiometric measurement methods using neutrons and gamma radiation are described with emphasis on the neutron method. The classical and radiometric methods are compared. The radiation protection needed in the use of the radiometric methods is described. (JSR)

19948 (EURISOTOP-69) RADIOMETRIC FILLING MEASUREMENT AND CONTROL. Heier, K.; Trost, A. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). May 1972. 103p. (In German). Dep. NTIS (U. S. Sales Only).

A review is given of radiometric filling measurement methods. Nonnuclear methods are briefly outlined. The physical bases and input magnitudes of nuclear filling methods are discussed with a consideration of absorption methods, backscattering methods, input magnitudes, and radiation statistics. Measurement devices consist of the radiation emitter and its holder, the detector, and the measurement preamplifier. These components are described. Portable and fixed measurement installations are discussed. Examples are given of their use. The radiation protection needed is discussed. An economic evaluation is made of radiometric methods for filling measurement and control. (JSR)

19949 (EURISOTOP-76) RADIOMETRIC CONTROL METHODS IN THE TEXTILE INDUSTRY. Wegener, W. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). Sep 1972. 49p. (In German). Dep. NTIS (U. S. Sales Only).

A review is given of the various radiometric applications in the textile industry. The advantages and disadvantages of radiometric measurement methods with respect to conventional methods are described on the basis of some concrete examples. The control of the uniformity of the weight of equal lengths, the control of the uniformity of the surface weight, and the control of the uniformity of impregnations, dyes, and coatings were specifically cited. The automatic assortment of yarns, moisture measurements, the control of the uniformity of drying and dampening procedures, the evaluation of the wear of surfaces, and the control of the filling and density of containers were also measured by radiometric methods. Some economic aspects of the use of radiometric methods were also considered. (JSR)

19950 (RISO-M-1450) DESCRIPTION OF THE MOPS-III PROGRAMME. Oelgaard, P. L. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jul 1972. 42p. Dep. NTIS (U. S. Sales Only).

The MOPS-III program is intended for calculations of subsurface neutron moisture gages. The source-detector geometry of the probe is a line detector for thermal and epithermal neutrons and a fast neutron point source situated anywhere on the detector axis. MOPS-III allows calculation of calibration curves for such gages with the probe situated in a medium of known composition. It also allows experimental input count rates to be compared with corresponding calculated count rates. The probe may be situated in an infinite medium or in a finite spherical medium with the source at the center of the sphere. The theoretical basis of the program is discussed. Also instructions on the use of the program, a printout of the complete ALGOL program

and a test example with description of input and output are given. (auth)

19951 MELTING CRYOGEN COOLING FOR RADIATION LOGGING PROBE. Tanner, A. B.; Senftle, F. E.; Moxham, R. M. (to United States Atomic Energy Commission). U.S. Patent 3,702,932. 14 Nov 1972. Filed date 15 Apr 1971. 6p.

A borehole logging probe for mineral or petroleum exploration is disclosed having a californium-252 neutron source for activating elements adjacent to the borehole and a solid state detector for sensing resulting radiation. The probe includes an elongated water-tight housing having a shielded compartment for the neutron source, and a thermally insulated compartment for containing the radiation detector. A reservoir is filled with a fusible solid cryogen and located within the insulated compartment adjacent to the detector with a thermal conduction member disposed to cool the radiation detector by transferring heat to the solid cryogen. (Official Gazette)

19952 IMPROVEMENTS IN OR RELATING TO LEVEL DETECTION. McDonald, B. J.; Fox, G. H. (to United Kingdom Atomic Energy Authority). British Patent 1,298,073. 29 Nov 1972. Filed date 23 Jun 1969. 3p.

Apparatus is described, based on γ-absorption, for the determination of levels, such as those of powder in a container. The method has the advantage that a sensor probe does not have to be inserted in the powder, and a simplified system is provided for multilevel determinations. Two γ-sources are provided, located one above the other outside the container, with a single γ-detector at an intermediate level and two collimators arranged one above the other at suitable angles. (UK)

19953 THICKNESS CHANGE RADIATION GAUGE. Busch, E. R.; Wood, G. B. (to Western Instruments, Inc.). U. S. Patent 3,715,592. 6 Feb 1973. Filed date 12 Jan 1971. 8p.

A technique for accurately observing relative changes in strip thickness during sheet metal rolling operations is described. This is accomplished by measuring the apparent attenuations of two collimated beams of radiation. The prime radiation beam and the scanning beam, for instance, are tilted in opposite directions relative to the plane of the longitudinally moving metal strip in order to provide clearance for the radiation sources and associated detectors during traverse across the strip width. These tilted beams enable the relative change in strip thickness to be measured at essentially the same longitudinal position. (8 claims, 4 drawing figures) (Official Gazette)

19954 WATER LEVEL GAUGE USING NEUTRON SOURCE. Olesen, B. D. (to Secretary of the Navy). U. S. Patent 3,716,711. 13 Feb 1973. Filed date 18 Jun 1971. 6p.

A radioactive source of energy emitting neutrons is placed adjacent to a sunken hull and neutrons pass relatively unimpeded through the steel hull and, if included, an internal thermal insulator to a compartment interior. If the compartment is unflooded, most neutrons continue on their way, but if the interior is filled with water, a great many of the neutrons are partially backscattered as they encounter the water medium with a percentage of the backscattered neutrons impinging on a particle detector. The particle detector produces signals representative of the backscatter intensity to an indicator which provides an indication to a diver as to whether or not a compartment is flooded. By relocating the invention along the vertical dimension of the compartment and noting where there is an insignificant level of back-scattering, the level to which the chamber is flooded is determined from the vessel's exterior. (Official Gazette)

19955 THICKNESS MEASUREMENTS USING THE MOESSBAUER EFFECT. Cohen, R. L. (to Bell Telephone Labs., Inc.). U. S. Patent 3,716,715. 13 Feb 1973. Filed date 4 Dec 1970. 6p.

Resonant gamma ray absorption techniques (Moessbauer effect) are used to monitor the thickness of foils or deposited layers containing tin, iron and a number of other elements. The measurements are nondestructive and largely independent of environmental factors such as surface residues (e.g., chemical salts or dirt) and surrounding fluids (e.g., lubricants or plating baths). (Official Gazette)

19956 PROCEEDINGS OF THE THIRTIETH ANNUAL MEETING OF THE ELECTRON MICROSCOPY SOCIETY OF AMERICA AND FIRST PACIFIC REGIONAL CONFERENCE ON ELECTRON MICROSCOPY, LOS ANGELES, CALIFORNIA, AUGUST 14–17, 1972. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972). 725p. (CONF-720842).

A total of 348 brief summaries are included, which are arranged into sections covering: cytochemistry and histochemistry, bone and muscle, sensory morphology, pathology, reproductive systems, fixation and embedding, invertebrate morphology, molecular biology, botany, cytology, virology, biological techniques, microbiology, tracer methodology and induced tissue changes, atmospheric pollution, scanning electron microscopy techniques, ultramicrotomy and diamond knives, x-ray safety, instrumentation, high-voltage electron microscopy, microelectronics, thin films, nonmetals and minerals, lattice imaging, composites, image analysis, physical techniques and electron diffraction, metals, fractography, radiation effects, and technique demonstration. Twenty-eight of the summaries are listed and indexed separately for NSA. (DLC)

For abstracts of individual papers see: 19636–19638, 20030, 20137–20139, 20254–20259, 20297, 20370–20375, 20388–20392, 21480, 21516, and 21517.

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

19957 (SLA-73-13) IONIZING RADIATION EFFECTS IN THE INSULATOR REGION OF MOS DEVICES. Gwyn, C. W. (Sandia Labs., Albuquerque, NM). Jan 1973. 45p. Dep. NTIS.

The effects of ionizing radiation in the oxide insulator are summarized and the models which have been proposed to describe the hole trapping are described. Based on previous experimental results, it is concluded that hole trapping in early commercial devices was produced primarily by intrinsic trapping while the trapping in hardened devices is produced by both intrinsic and extrinsic hole traps. (auth)

19958 LOW-ENERGY-ELECTRON IRRADIATION OF THE Si/SiO_2 INTERFACE. Pepper, M. (Plessey Co. Ltd., Towcester, Eng.). Thin Solid Films; 14: No. 1, S7-S10(1 Dec 1972).

SiO_2 films were formed on Si substrates by thermal oxidation at 1000°C and were metallized with Al. The MOS capacitors were irradiated with 10- and 20-keV electrons. Capacitance–voltage measurements at 300 and 80°K were used to determine changes in the oxide charge (Q_{ox}) and the difference (N_t) in the flat band charges at the two temperatures. Irradiation of capacitors which had not received a low-temperature anneal caused an increase in both Q_{ox} and N_t, but these increases varied among the capacitors. Capacitors which received a low-temperature anneal before irradiation showed a smaller increase in Q_{ox}, and the rate of increase in N_t was the same for all capacitors. This is due to the increased concentration of H in the SiO_2. Possible mechanisms are discussed. (DLC)

19959 EFFECTS OF BORON DENSITY ON RADIATION RESISTANCE OF COPPER–CONTAMINATED N/P TYPE SILICON SOLAR CELLS. Kato, Y.; Usami, A. (Nagoya Inst. of Tech., Japan). Electron. Lett.; 9: No. 2, 18-19(25 Jan 1973).

The radiation-resistance properties of copper-contaminated n/p type cells are observed only when the copper concentration is larger than the boron density in the bulk region of the cells. The values of $\Delta(1/L^2)$ on n/p type cells are not always proportional to the boron density in the bulk region. (auth)

Miscellaneous Instruments

Refer also to abstracts 20294, 21642, and 21881.

19960 (AD–750759) EXTENDED ARRAY EVALUATION PROGRAM. Quarterly report No. 1, 1 April–30 June 1972. Harley, T. W. (Texas Instruments Inc., Dallas). 15 Jul 1972. Contract F33657-72-C-0725. 16p. NTIS.

The first quarterly report summarizes progress under the extended evaluation of the ALPA, NORSAR, and LPE program. Work through 30 June 1972 in the following areas is summarized: ALPA evaluation; NORSAR long period evaluation; NORSAR short period evaluation; LPE evaluation; and network analysis. (NTIS)

19961 (AD–852990) LONG-PERIOD TRIAXIAL SEISMOGRAPH DEVELOPMENT. Final Report, 15 June 1966–28 Feb 1969. Simmons, A. W. (Geotech, Garland, Tex.). May 1969. Contract AF33(657)-16406. 164p. NTIS.

A long-period triaxial seismometer was designed for shallow hole operation. The design has preserved ideal "la coste" geometry, in that changes in period are accomplished through a controlled positive restoring force. Laboratory tests and field evaluations were made to determine the effect of temperature and tilt on mass position and free period of the seismometer. (auth)

19962 (DNPL/R-23) CAMAC SYSTEMS: A PEDESTRIAN'S GUIDE. Zacharov, B. (Daresbury Nuclear Physics Lab. (England)). 1972. 44p. Dep. NTIS (U. S. Sales Only).

A description is given of the CAMAC (Computer Application to Measurement and Control) system, covering both hardware and software aspects. It is stated that the CAMAC system was developed to standardize the method for the transmission of data and control between instrumentation modules and a digital controller. In addition, it defines the precise mechanical format of both module and crate, together with certain signal and power supply conventions. The subject is covered in sections: the dataway (dataway operations, status signals, block transfers); multi-crate systems (the branch highway, demand handling, the crate controller, the branch driver, multi-branch systems, typical transfer times); CAMAC modules; software for CAMAC; applications of CAMAC systems. (UK)

19963 (JINR-E13-6674) FAST DISCRIMINATORS. Horvath, P.; Mukhin, S. V.; Rikhvitskii, S. V.; Streit, V.; Zvada, M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 31p. Dep. NTIS (U. S. Sales Only).

Fast discriminators intended both for front-edge timing and amplitude selection are described. Triggering rate of the discriminators is 100 to 200 MHz, input signal resolution is 5 to 10 ns, output pulse pair resolution is 8 ns, dynamic range of input pulse amplitudes is 46 to 52 dB, and the temperature range for reliable module operation is 15 to 55°C. The devices are designed by the Joint Institute for Nuclear Research. (auth)

19964 (LA-5139) NEW LAMINATED BUS FOR THE NUCLEAR INSTRUMENT MODULE SYSTEM. Lindsay, N. A.; Pollat, L. L. (Los Alamos Scientific Lab., N. Mex.). Jan 1973. Contract W-7405-eng-36. 12p. Dep. NTIS.

A new design for a Nuclear Instrument Module (NIM) laminated bus is presented. Electrical performance and fabrication concepts are discussed. (auth)

19965 (RDT-F-3-2-T(2-73)) CALIBRATION PROGRAM REQUIREMENTS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Feb 1973. 5p. RSO.

A standard prescribing requirements for the establishment and maintenance of a calibration program to measure and verify the accuracy of all measuring and test equipment for nuclear and associated applications is presented. (RCK)

19966 DIGITAL PULSE GENERATOR FOR NUCLEAR MAGNETIC RESONANCE EXPERIMENTS. Sajeva, A.; Stanchi, L. (CCR-EURATOM, Ispra, Italy). Nucl. Instrum. Methods; 106: No. 3, 549-556(1973).

Nuclear magnetic resonance (NMR) experiments require well defined pulse sequences. The appropriate use of a few identical standard units in connection with a control unit permits the solution of a very large number of physical problems. Each pulse sequence is produced in a separate plug-in unit driven by a general trigger. The modular method enables easy performance of the experiments required by the NMR laboratory. Future extensions for more sophisticated experiments are also easily achieved. (auth)

19967 DESIGN AND PERFORMANCE OF A MASS SPECTROMETER USING BEAM TRANSPORT THEORY. Clement, S.; Compston, W. (Australian National Univ., Canberra). J. Mass Spectrom. Ion Phys.; 10: No. 3, 323-42(Jan 1973).

It is demonstrated that the concepts and techniques of beam transport theory can be usefully applied to mass spectrometer design. Most important among these concepts is that of beam emittance. It can be shown that the emittances in both y and z phase spaces are finite and that, for thermal ionization sources, their magnitude is due to the initial Maxwellian velocity distribution of the ions. For maximum transmission these emittances must be matched to the phase space acceptance of the analyzer and collector system. A theoretical study has led to the design of a system, consisting of three quadrupole lenses whose strength and spacing are determined, which provides the required matching between ion source and analyzer. The exact ion transmission efficiency obtainable is a definite function of filament temperature and accelerating voltage. This focusing system has been incorporated in a new mass spectrometer suitable for Rb/Sr or Pb/U isotopic analyses. The performance of this instrument is satisfactory and tests indicate that the transmission efficiency achieved is close to the theoretical optimum of approximately 65 percent. (auth)

19968 MOVING CRYSTAL SLOW-NEUTRON WAVELENGTH ANALYSER. Buras, B.; Kjems, J. K. (Atomic Energy Research Establishment, Risoe, Denmark). Nucl. Instrum. Methods; 106: No. 3, 461-464(1973).

Experimental proof that a moving single crystal can serve as a slow-neutron wavelength analyzer of special features is presented. When the crystal moves with a velocity h/(2 md) (h—Planck constant, m—neutron mass, d—interplanar spacing) perpendicular to the diffracting plane and the analyzed neutron beam is parallel to the diffracting plane, then neutrons of different wavelengths contained in the incident beam are simultaneously diffracted under different reflection angles and recorded by a position-sensitive detector. Special features of this analyzing system are briefly discussed. (auth)

19969 HIGH SPEED DECIMAL SCALER WITH A CENTESIMAL TOP COUNTING STAGE. Inaba, S.; Husimi, K. (Tokyo Univ.). Nucl. Instrum. Methods; 106: No. 3, 563-567(1973).

A high speed decade scaler with a unique centesimal counter at the top stage has been designed using integrated circuits. The centesimal counter consists of two high speed IC flip-flops and two quinary counters in series. By using this circuit configuration, it is possible to improve the counting rate of this decade scaler up to the maximum rate of the first flip-flop. This method will be superior in many respects compared with other methods of high speed decimal counting. (auth)

19970 REDUCTION OF THE COUNTING LOSSES IN A TIME ANALYSER BY THE USE OF AN INTERMEDIATE MEMORY. Salama, M.; Hamouda, I. (Atomic Energy Establishment, Cairo). Nucl. Instrum. Methods; 106: No. 3, 589-593(1973).

In the analysis of time-of-flight experiments the counting losses due to the various counting components may cause serious disturbance to the spectral data obtained. The dead time of the time analyzer contributes most to the counting losses. A theoretical formula was introduced to estimate the correction for counting losses in the case of constant counting rates in all the analyzer channels. Experimental checking of the spectrum distortion at constant pulse rates at the analyzer input has been investigated. The time analyzer used in this experiment is composed mainly of a time-to-pulse height converter and a multi-channel pulse height analyzer. To reduce counting losses, we have used an additional pulse height analyzer in parallel with the main analyzer to act as an intermediate memory. It was found that this method helps to reduce appreciably the counting losses of the time analyzer. (auth)

19971 EFFICIENCY OF VERTICALLY BENT NEUTRON MONOCHROMATORS. Currat, R. (Inst. Max von Laue Paul Langevin, Grenoble, France). Nucl. Instrum. Methods; 107: No. 1, 21-28(15 Feb 1973).

Following a simple geometrical approach, expressions for the bent crystal efficiency, relative to the flat crystal case, in all possible configurations (underfocused, focused, overfocused) are derived. These expressions are then used to study the variation of crystal efficiency with incident neutron energy. The calculation shows that the full intensity gain can be achieved over an appreciable energy range around the focusing energy, in agreement with existing data. The effect of vertical mosaicity is briefly discussed in an appendix. (auth)

19972 COLD NEUTRON MONOCHROMATIZATION BY MEANS OF TOTAL REFLECTION. Fiala, W. (Univ. of Puerto Rico, Mayaguez); Foote, H. L. Jr. Nucl. Instrum. Methods; 107: No. 1, 33-36(15 Feb 1973).

The principal performance of a neutron monochromatizer consisting of two mirrors was tested. Two successive mirror reflections provided filtering of the neutron beam from both smaller and larger wavelengths. The experiments included a detailed study of the cutoff behavior of physical neutron mirrors. Suggestions for future developments of neutron monochromatizing mirror systems are presented. (auth)

19973 DETAILED EVALUATION OF NEUTRON MIRROR MONOCHROMATIZING SYSTEMS. Fiala, W.; Delsanto, P. P. (Univ. of Puerto Rico, Mayaguez). Nucl. Instrum. Methods; 107: No. 1, 37-43(15 Feb 1973).

A theoretical evaluation of neutron mirror monochromatizing systems incorporating plane mirrors is presented. The dependence of the resolution and of the economy of the systems on the different parameters involved is discussed. Optimum parameter configurations are given. The study includes a comparison of the mirror technique with other established methods. (auth)

19974 ERROR ESTIMATES IN HIGH COUNT RATE EXPERIMENTS. Chrisman, B. L. (National Accelerator Lab., Batavia, IL); Groves, J. L. Nucl. Instrum. Methods; 107: No. 1, 193-194 (15 Feb 1973).

The effects of pulse counting rate on chi-square calculations for the experimental arrangement used in Moessbauer effect studies are studied. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstracts 19588 and 19853.

19975 (K-OA-1678) CARBON-13 UNIT PRODUCT COSTS. Hoglund, R. L.; Roberts, D. J. (Oak Ridge Gaseous Diffusion Plant, TN). 12 Feb 1969. Contract W-7405-eng-26. 41p. Dep. NTIS.

The AEC has embarked on a market survey for enriched ^{13}C and requested a preliminary study of ^{13}C unit product costs. In response to this request, an investigation of the cost of enriching ^{13}C to 60 and 90% purity at production rates of 10, 50, and 400 kg ^{13}C/yr was conducted by evaluating the application of the CYANEX, CO distillation, thermal diffusion, and gaseous diffusion processes to this task. This analysis shows the CYANEX process to be the best candidate for large-scale production (50 to 400 kg ^{13}C/yr). At lower production rates, the unit product costs for the CYANEX and CO distillation processes are comparable. A summary of unit product costs as a function of production rate for 90% enrichment is shown. The equipment and cost breakdown sheets for each process are included. This preliminary cost analysis is based on general considerations, thus a development program for generating more accurate data is needed for more reliable results. (auth)

19976 (ORNL-TM-4116) BYPASSING THE INSTABILITY-INDUCED THROUGHPUT LIMIT IN CALUTRON ISOTOPE SEPARATORS. Alexeff, I. (Oak Ridge National Lab., Tenn.). Feb 1973. Contract W-7405-eng-26. 8p. Dep. NTIS.

A method for bypassing the instability-induced throughput limit in calutron (magnetic mass-analysis) type isotope separators is discussed. It was demonstrated both experimentally and theoretically that the isotron (time-of-flight) type of isotope separator is relatively immune to this type of instability, although still susceptible to the limitation due to the granular nature of the ion beam. Depending on the severity of this latter limit, the throughput limit of an isotron could be up to several orders of magnitude greater than that of a calutron. (auth)

19977 URANIUM ENRICHMENT STATUS IN FREE WORLD. Tokyo; Japan Atomic Industrial Forum, Inc. (1972). 23p. (In Japanese).

A stabilized supply of enriched uranium is essential in Japan's power generation by nuclear energy, therefore, a close scrutiny both by the Government and private circles is required. This, then must be based on accurate information from various quarters on the world's development. The results of studies made in this connection by JAIF are described as follows: demand and supply situation including uranium enrichment requirement, timing of constructing new enrichment plants, the U. S. AEC's capacity expansion program, the U. S.'s expected supply to the free world, uranium enrichment by gaseous diffusion, capability of countries other than the U. S., the effect of introducing future-type reactors: enrichment programs of various countries, including the U. S., joint Holland-U.K. W. Germany, the U. K., France, Germany, Canada, and EC; current and future charges for enrichment services including cost in the U. S. and U. S. S. R. (JA)

19978 MOTION OF SMALL SPHERES IN GASES. I. GENERAL THEORY. Williams, M. M. R. (London Univ.). Z. Naturforsch.; 27a: No. 12, 1798-1803(Dec 1972).

A global scattering kernel which describes the scattering of gas atoms by spherical particles which are small compared with a mean free path in the gas is described. The global kernel, which is analogous in many ways to the thermal neutron scattering kernel employed in neutron thermalization studies, is given in terms of the gas-surface scattering law for the particle. Thus, the global kernel can be studied as a function of specular reflection and incomplete accommodation. The recent model of Kuščer and of Cercignani is used for the latter investigation which that on the average the angular distribution of the scattered gas atoms depends sensitively on the tangential momentum accommodation coefficient but only very weakly on the energy coefficient. However, the phenomenon is strongly dependent on the speed of the approaching gas atom and, for low speed gas atoms, the sensitivity to energy accommodation becomes much more important. The net scattering rate is obtained and put in a form convenient for later calculations to be described in a series of companion papers. (auth)

19979 MOTION OF SMALL SPHERES IN GASES. II. THERMO-PHORESIS, DIFFUSIO-PHORESIS, AND RELATED PHENOMENA. Williams, M. M. R. (London Univ.). Z. Naturforsch.; 27a: No. 12, 1804-11(Dec 1972).

Using the general theory developed in a previous paper, the problems of thermophoresis and diffusio-phoresis were examined with a view to elucidating the effect of a general gas-surface scattering law on the associated forces. It was found that, in thermo-phoresis, there exists a close coupling between the first anisotropic moment of the gas-surface scattering law and the solution of the Chapman–Enskog conductivity equation. Explicit calculations indicate that for an arbitrary combination of any type of purely elastic scattering, e.g., specular, Lambert or backward, there is no change in the creep velocity of the particle. On the other hand, diffuse scattering with redistribution leads to a marked decrease in the creep velocity. These conclusions are independent of the force law between gas atoms and depend only on the gas-surface interaction. In diffusio-phoresis, using only the simplest Chapman–Enskog solution for a binary mixture, it was found that unless the gas-surface laws differ greatly for the two species, there is virtually no influence of gas-surface scattering on the particle motion: the effect is due almost entirely to the mass difference and concentration ratio. The way in which particles move in gas streams close to boundaries was studied. Slip flow was used as an example. It was shown that for diffuse reflection a particle at the wall travels with a speed which is about 60% of the gas speed at the wall. (auth)

19980 PROCEDURE FOR EXTRACTION OF DEUTERIUM. Pachaly, R. W. (to Gulf Research and Development Co.). Danish Patent 523,471. 27 Oct 1971. Priority date 29 Oct 1970, United States. (In Danish).

A procedure is described for transfer of deuterium from a comparatively hydrogen-rich basic material containing deuterium. The basic material is brought into contact with hydrogen with reduced content of deuterium and a hydrogenation-dehydrogenation catalyzer at a raised temperature, resulting in the formation of hydrogen enriched in deuterium and basic material with a reduced content of deuterium. The two resulting products are then separated. (auth)

Isotopic Power Sources

Refer also to abstract 19738.

19981 (LA-5017-MS) DART TECHNOLOGY DEVELOPMENT. Final Report. Cooper, K. C.; Turner, W. C. (Los Alamos Scientific Lab., N. Mex.). Dec 1972. Contract W-7405-eng-36. 40p. Dep. NTIS $4.00.

Technology development for a Decomposed Ammonia Radioisotope Thruster (DART) of 0.01 to 0.1 lb thrust was performed at the Los Alamos Scientific Laboratory (LASL). Design, materials and fabrication, and testing results are presented. Assembly of a rhenium heat exchanger, including nozzles and inlet tubes, was accomplished with electron beam welding. A useful series of molybdenum–rhenium alloys with from 20 to 46 wt % rhenium was prepared, using electron beam melting for purity. Molybdenum foam was brazed to molybdenum sheet. Diffusion couples were tested at operating conditions, and compatibility for 500 h was established between: carbon vs beryllia, carbon vs tungsten, iridium vs molybdenum–rhenium, zirconia vs tungsten, zirconia vs molybdenum, hafnia vs tungsten, and hafnia vs molybdenum. Testing showed the adequacy of the graphite reentry ablation structure. Electrically-heated tests demonstrated adequacy of the multi-foil thermal insulation, and of the heat pipes for prelaunch cooling. Energy absorption data were obtained on foam and drilled molybdenum, which are promising as cushioning for the radioisotope fuel against impact. The original impact capsule, of threaded molybdenum, was inadequate against impact, but a welded molybdenum–rhenium capsule behaved satisfactorily. Rhenium was a satisfactory catalyst for decomposition of the propellant ammonia. (auth)

19982 (MLM-1983) MOUND LABORATORY ISOTOPIC POWER FUELS PROGRAMS: JULY–SEPTEMBER 1972. (Mound Lab., Miamisburg, Ohio). 30 Nov 1972. Contract AT-33-1-GEN-53. 26p. Dep. NTIS.

Research progress is reported on ^{238}Pu fuels for isotopic power sources including fuel preparation, fuel characterization, process studies, capsule design and testing, and creep studies and internal structure studies of refractory metals and alloys. (TFD)

19983 (MLM-2014) MOUND LABORATORY ISOTOPIC POWER FUELS PROGRAMS: OCTOBER–DECEMBER 1972 (Mound Lab., Miamisburg, OH). 31 Jan 1973. Contract AT-33-1-GEN-53. 23p. Dep. NTIS.

Technological achievements in the isotopic fuels program during Oct. through Dec. 1972 are reported and include: processing of sufficient fuel to fuel Pioneer capsules 18, 19, and 20 and RITE II capsules; fabrication of 6 pressed plutonium oxide (PPO) spheres for the multihundred watt program and measurement of property data for these spheres; acoustic emission testing to monitor the cracking of PPO spheres under thermal stress; studies of the effects of calcination temperatures and hydrofluoric acid concentration on the dissolution of PuO_2; and development of new methods for decladding molybdenum-coated ceramic particles. Activities concerned with capsule design and testing included development of techniques for preparing iridium samples for examination by transmission electron microscopy, and studies of the compressive and tensile creep of molybdenum. (LCL)

19984 (ORNL–4840) ORNL ISOTOPIC POWER FUELS QUARTERLY REPORT FOR PERIOD ENDING SEPTEMBER 30, 1972. Lamb, Eugene (Oak Ridge National Lab., Tenn.). Nov 1972. Contract W-7405-eng-26. 8p. Dep. NTIS.

A number of materials have been selected for evaluation as a container for $^{244}Cm_2O_3$ in radioisotopic power generator applications from 900 to 1400°C. Ceramic materials may be desirable as either primary encapsulants or as liners in the assembled curium sources. ThO_2 was chosen as a ceramic material to be included in compatibility tests. Interaction of BeO and $^{244}Cm_2O_3$ was studied experimentally, and results from this study eliminated BeO from the test materials. A mixture of SiC–Cm_2O_3 will be studied experimentally to determine the suitability of SiC as a material for further compatibility tests. The volatile transport of CM_2O_3 in vented heat sources is being studied. A high-temperature furnace equipped with a quadrupole mass spectrometer is being used to obtain the equilibrium vapor pressure of $^{244}Cm_2O_3$ in the temperature range 900 to 1527°C and for identification of the volatile species over $^{244}Cm_2O_3$ in the temperature range 900 to 2300°C. An x-ray diffraction unit for radioactive materials is being readied for characterization of ^{244}Cm materials. Work was resumed on recovery of the Cm_2O_3 fuel from the tungsten fuel block. The capsule has been stored under argon atmosphere in a sealed container. The loss of structural properties of sabot materials at test conditions resulted in a redesign of the sabot heater units. The diameter of the impact cup was reduced sufficiently to prevent the swaging heater walls from trapping the cup. (auth)

Radiation Sources

Refer also to abstracts 19857, 19874, 19883, and 19911.

19985 (AE–462) ELECTRODEPOSITION OF POINT $Cu^{125}I$ ROENTGEN SOURCES. Beronius, P.; Johansson, B.; Soremark, R. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Dec 1972. 12p. Dep. NTIS (U. S. Sales Only).

The experience gained in the present study concerning the "optimum" conditions for preparation of "point" Cu ^{125}I roentgen sources may be summarized as follows. Radioiodide is anodically deposited at room temperature on the semi-spherical end face of a 0.5 mm diameter copper wire using an electrolytic cell. The electrolyte consists of 2 ml aqueous solution of 4×10^{-4} M sodium radioiodide (1750 mCi $^{125}I^-$) free from reducing agents and with a pH of 9.0. By using a constant current of 0.6 μA, 90% of the iodide content of the solution, corresponding to 1600 mCi of ^{125}I, is deposited as copper radioiodide on the anode surface after electrolysis for 4.5 days. The deposit formed under these conditions is smooth and adherent. (auth)

19986 (COO-2063-19) EVALUATION OF THE 200 mCi ^{55}Fe X RAY DIFFRACTION SOURCE IN FOCUSING AND DEBYE–SCHERRER ANALYTICAL APPLICATIONS. Final report, June 15, 1969–March 14, 1972. Preuss, L. E.; Bugenis, C. K. (Edsel B. Ford Inst. for Medical Research, Detroit, Mich. Div. of Nuclear Spectroscopy and Radiation Physics). Feb 1973. Contract AT(11-1)-2063. 161p. Dep. NTIS.

A 200 mCi metallic, linear ^{55}Fe deposit was studied as a source of x rays for application in analytical powder x-ray diffraction. Conventional Debye–Scherrer and focusing, back-reflection modes were investigated. Usable analytical patterns were produced in both geometries. Exposure times and line resolution were evaluated. Iron-55 production methods as well as deposit fabrication were dealt with. Potential areas for source improvement are pointed out. Iron-55 is compared with other low-energy photon-emitting isotopes for use in analytical diffraction systems. Camera design adapted to isotopic source usage is detailed. Diffraction patterns, useful in analysis, with resolution approaching, but not fully equivalent to, those of the machine source were obtainable with the ^{55}Fe test source at hand. These patterns required relatively longer exposure periods due to the low source intensity of the available isotope x-ray source. It is concluded that improvements in source intensity, purity and geometry are feasible and that such an improved ^{55}Fe source could, with competitive exposure times, produce analytical patterns of quality equal to those presently machine produced. (auth)

19987 CALCULATION OF THE SELF-ABSORPTION OF GAMMA RAYS IN A DISC SHAPED SOURCE. Gotoh, H. (Japan Atomic Energy Research Inst., Tokai). Nucl. Instrum. Methods; 107: No. 1, 199(15 Feb 1973).

Two kinds of calculation methods—a Monte Carlo method and a non-statistical one—are proposed for the self-absorption of gamma rays in a disk-shaped source. (auth)

Design and Fabrication

Refer also to abstract 20081.

19988 (ANL-Trans-934) POWERFUL ^{244}Cm–BERYLLIUM SOURCE. Tyufyakov, N. D.; Shtan, A. S.; Trykov, L. A.; Fadeev, Yu. V.; Chushkin, Yu. V.; Stelnikov, G. N.; Luzin, Yu. N.; Zinkovskii, V. I. Translated by Gerda L. Siegel (Argonne National Lab., Ill.).

From At. Energ. (USSR); 32: No. 3, 237-238(1972). 4p. Dep. NTIS.

An experimental ^{244}Cm–Be source was prepared which yielded (4π geometry) 1.8×10^9 n/sec. A mixture of Cm oxide and powdered Be metal was sealed in a double ampule of stainless steel with an outer diameter of 35 mm and a height of 60 mm. The energy spectrum of the unit from 0 to 12 MeV is shown graphically, the average value being 3.6 MeV. A comparison with other neutron sources is described. (KSW)

Industrial Uses

Refer also to abstracts 20021, 20029, and 20032.

19989 INVESTIGATION OF THE CRYSTALLIZATION FRONT AND THE DEPTH OF THE LIQUID PHASE IN CONTINUOUS CAST MATERIAL USING RADIOISOTOPES. Firganek, H.; Siewierski, J.; Labus, J. Neue Huette; 17: No. 11, 683-686(Nov 1972). (In German).

The continuous casting of various steels which were labeled with ^{32}P was studied. The activity amounted to approximately 0.1 mCi/kg. Cross sections of cast rods were studied by autoradiography. The results yielded information about optimal casting velocity and cooling. (HBG)

19990 UTILIZATION OF NONRADIOACTIVE INDICATORS IN STUDIES OF THE ORIGIN OF NONMETALLIC SURFACE INCLUSIONS IN PRODUCTS OF CONTINUOUS CASTING. Kolaski, H.; Siewierski, J.; Labus, J.; Wieczorek, E.; Diaczuk, H. Neue Huette; 17: No. 11, 686-689(Nov 1972). (In German).

The degree to which nonmetallic surface inclusions originated from the slag of the intermediate pan, the fire-brick of the intermediate pan, and from the zirconium in the spout of the intermediate pan was studied. Both slag and fire-bricks were labeled with lanthanum oxide, while the zirconium contained naturally sufficient hafnium. Samples were irradiated in a nuclear reactor. ^{140}La was measured approximately five days after activation using γ-spectrometry, and ^{181}Hf at about 30 days after activation, respectively. Results showed that neither slag nor fire-brick nor zirconium contributed significantly to nonmetallic surface inclusions. They must therefore originate as products of the secondary steel oxidation during the casting process. (HBG)

19991 PRIMENENIE RADIOAKTIVNYKH INDIKATOROV DLYA ISSLEDOVANIYA METALLURGICHESKIKH PROTSESSOV. (Use of Radioactive Indicators for Investigating Metallurgical Processes). Belyaev, Yu. P. Moscow; Atomizdat (1972). 96p.

The physicochemical bases of radioactive indication are reviewed: the choice of radioactive isotopes for given industrial investigations, their preparation, and subsequent determination of their distribution. Examples are given of the use of radioisotopes in several metallurgical processes, and in studies of the hydrodynamics of liquid metal systems. 29 references. (KSW)

19992 USE OF RADIONUCLIDES FOR CAVITATION, WEAR, AND OIL CONSUMPTION MEASUREMENTS IN ENGINE CONSTRUCTION. Bentele, W. (Daimler-Benz AG, Stuttgart).

Kerntechnik; 14: No. 12, 584-590(Dec 1972). (In German and English).

It is shown that the use of radionuclides makes it possible to carry out within relatively short times, and therefore economically, continuous measurements which cannot be carried out by conventional methods. In connection with oil consumption measurements it is shown that the tritium flow method makes it possible to measure not only the total oil consumption but also that of individual cylinders of an engine. (auth)

19993 "SMALL UNICELL" GAMMA IRRADIATION PLANT SUPPLIED TO THE SSC STERIL CATGUT GESELLSCHAFT, NEUHAUSEN, SWITZERLAND. Sieber, A. (Winterthur Engineering Works Div., Switzerland). Sulzer Tech. Rev.; No. Nuclex 72, 105-108(1972).

The constructional design and operation of the Small Unicell gamma irradiation plant, as well as various measurements carried out to test the safety of the radiation screening provided are described. (auth)

19994 RADIATION EFFECTS ON FOOD. No. 11. Beising, K. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1972). 119p.

The bibliography on food irradiation is continued. The present issue covers further literature on feeding experiments with irradiated foodstuffs published during the last few years, as well as recent publications dealing with the subject of food irradiation. It likewise covers the literature closely related to this subject, i.e., publications on microorganisms and insects having a harmful effect on food, on various devices for the irradiation of foodstuffs, and on chemical effects on food. The types of literature included in the bibliography are conference proceedings, reports, dissertations, patents, review articles and books. (GF)

19995 TRITIUM-TRACER TECHNIQUE FOR THE MEASUREMENT OF OIL CONSUMPTION IN GASOLINE AND DIESEL ENGINES. Evans, R. (Shell Research Ltd., Chester, Eng.). Int. J. Appl. Radiat. Isotop.; 24: No. 1, 19-27(Jan 1973).

A rapid and reliable means for measuring lubricating oil consumption in a test-bed engine is described that uses a technique which is particularly valuable for assessing the influence of oil properties on consumption. The lubricating oil is labelled with tritium over its complete boiling range by catalytic exchange with tritiated water, and the tritiated product is subjected to vacuum fractionation and re-blended to give a product of uniform specific activity. Satisfactory correlation is found between results from the tracer technique and those from a weight method and from a metered flow experiment. The need for stability of the tritium label is stressed and evidence for the stability of the labelled oils used in this work is presented. (auth)

LIFE SCIENCES

19996 (AECL-4360) BIOLOGY AND HEALTH PHYSICS DIVISION PROGRESS REPORT, JULY 1–SEPTEMBER 30, 1972. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs). Nov 1972. 66p. (PR-B-95). Dep. NTIS (U.S. Sales Only). AECL $1.50.

Research activities at Chalk River Nuclear Laboratories are reported for the period of July 1 to September 30, 1972. General areas of study included in the report are biology, population research, environmental research, and health physics. (ERB)

Radiation Effects on Biochemicals

Refer also to abstract 20012.

19997 X-RAY INACTIVATION OF THE ESCHERICHIA COLI DEOXYRIBONUCLEIC ACID DEPENDENT RIBONUCLEIC ACID POLYMERASE IN AQUEOUS SOLUTION. II. Studies on Initiation and Fidelity of Transcription. Strniste, G. F.; Smith, D. A.; Hayes, F. N. (Los Alamos Scientific Lab., NM). Biochemistry; 12: No. 4, 603-608(13 Feb 1973).

The ability of complementary ribosyl pentamers to bypass chain initiation and to stimulate poly(A) synthesis in poly(U)- and poly(dT)-directed reactions using the Escherichia coli DNA-dependent RNA polymerase was examined. Utilizing this method of bypassing the rate-limiting step in in vitro RNA synthesis, how x-irradiation influences inactivation of enzymatic activity of the RNA polymerase was investigated. It was previously shown that that x-ray inactivation of RNA polymerase, when assayed for enzymatic activity against homoribopolymers, was directly dependent on substrate concentration. At low substrate levels, where the initiation step is rate limiting, radiosensitivity of the RNA polymerase was most acute. However, the substrate-dependence phenomenon can be eliminated with addition to the reaction mixture of initiator molecules (oligomer primers). Furthermore, response of the irradiated enzyme, when assayed against homodeoxyribopolymers, becomes less radiosensitive in the presence of oligomer primers. The initiation process may account for the radiosensitive step in RNA synthesis. The fidelity of RNA synthesis by x-irradiated RNA polymerase was also examined. A linear increase in misreading, or insertion of noncomplementary nucleoside triphosphates into the RNA product, was found for both poly(U), and poly(dT)-directed synthesis of poly(A) as a function of dose. Misreading was three to four times more pronounced in poly(dT)-directed reactions compared to poly(U)-directed reactions. (auth)

19998 GAMMA-IRRADIATED FLAVIN ADENINE DINUCLEOTIDE: A D-AMINO ACID OXIDASE INHIBITOR. Winstead, J. A.; Moss, S. A. (School of Aerospace Medicine, Brooks Air Force Base, TX). Radiat. Res.; 52: No. 3, 520-527(Dec 1972).

Flavin adenine dinucleotide (FAD) was irradiated with ^{60}Co radiation and the chemical and biological properties were determined. The spectra showed both shifts and decrease of the absorption maxima at 375 and 450 nm indicating destruction of the isoalloxazine moiety of the FAD. A decrease in absorption at 260 nm was attributed primarily to the destruction of the flavin mononucleotide (FMN) moiety rather than the AMP portion of FAD. Biological activity in the D-amino acid oxidase system was rapidly decreased by irradiation. FAD irradiated in vacuo exhibited less destruction, thus indicating the "oxygen-effect." The irradiated FAD was found to be a competitive inhibitor for the D-amino acid oxidase. Since FAD is a coenzyme for a number of enzymes, irradiated FAD is predicted to be an inhibitor to any enzyme in which the adenine or AMP moiety is involved in binding to the "active site." (auth)

19999 INACTIVATION OF RIBONUCLEASE BY THE PRIMARY AQUEOUS RADICALS. Mee, L. K.; Adelstein, S. J.; Stein, G. (Hebrew Univ., Jerusalem). Radiat. Res.; 52: No. 3, 588-602(Dec 1972).

The separate contributions of the primary aqueous radicals to the changes in activity, molecular configuration, and amino acid composition of RNase, produced by γ irradiation of dilute solutions, were identified. The most effective radical for the inactivation of RNase is the H atom; approximately one out of four H atoms inactivates a RNase molecule, compared to 1 out of 15 OH or e^-_{aq}. Additional molecular products are formed on irradiation of the enzyme and when separated by gel filtration these were related to denatured and aggregated forms of the protein molecule. Hydroxyl radicals are most effective in forming molecular aggregates while H atom attack leads predominantly to denaturation. The solvated electron is the least effective radical for producing changes in molecular configuration; both denatured and aggregated products are formed. In the presence of oxygen, the denatured product forms few, if any, aggregates, due presumably to peroxy formation and an intramolecular termination of the radical. Amino acid analyses of the denatured and aggregated products indicate a very specific attack by the radicals. Significant changes are seen only in the sulfur-containing cystine and methionine and the aromatic tyrosine residues after low doses of irradiation. At higher doses there is, in addition, some effect on the aromatic phenylalanine residues. (auth)

20000 STUDIES ON THE ACTION OF γ IRRADIATION ON STARCH. Pt. 2. Development of certain biochemical characteristics of the starch granule as a function of the irradiation conditions. Tollier, M. T.; Guilbot, A. (Institut National de Recherches Agronomiques, Massy, France). Staerke; 24: No. 9, 285-290 (1972). (In French).

Cornstarch and potato starch were γ-irradiated at different hydrations with largely varying radiation doses. The radiation-chemical degradation of the units of the starch granule was examined. The products generating 5 HMF, the COOH groups, and the distribution of the modified anhydro-glucose units in the alcohol-soluble and the water-soluble fractions were determined. The results show that the amount of modified anhydro-glucose units, capable of forming 5 HMF on the action of acid, increases proportionally to the irradiation dose but is independent of the water content of the irradiated sample. On the other hand, the development of the amount of COOH groups provides evidence for the important protecting role that the water plays in this kind of alteration. When the alcohol-soluble fraction is expressed as a function of the water-soluble fraction, but insoluble in alcohol, a linear relationship is obtained, which is independent of the irradiation dose, of the hydration of the sample, and the origin of the treated starch. (GF)

20001 EFFECT OF ULTRAVIOLET IRRADIATION ON DNA METABOLISM IN CHLAMYDOMONAS REINHARDI. Swinton, D. C. Stanford, CA; Stanford Univ. (1972). 145p. University Microfilms Order No. 73-4606.

Thesis (Ph. D.).

Chlamydomonas reinhardi grown in vegetative culture was examined for its ability to excise pyrimidine dimers introduced into its DNA by ultraviolet irradiation, and for its ability to perform uv-dependent repair replication. In experiments measuring pyrimidine dimer excision, a chromatographic technique was devised to separate ^{32}P-labeled pyrimidine dimers of the form Py_PPy from $^{32}P_i$ in enzymatic digests of DNA. Application of this technique to highly purified Chlamydomonas DNA showed that pyrimidine dimers were induced in proportion to uv dose. Incubation of irradiated cells for various periods under non-photoreactivating conditions showed these dimers remain associated with both nuclear and chloroplast DNA. In these experiments, up to 26 hours were allowed for dimer excision from nuclear DNA and 2 hours for excision from chloroplast DNA. The number of dimers induced per erg into Chlamydomonas chloroplast DNA was similar to values measured in prokaryotic organisms, and that measured in Chlamydomonas nuclear DNA was similar to values measured in eukaryotic organisms. To measure repair replication in this organism a method was devised by which cell cultures could be grown and irradiated in the presence of ^{15}N, a closed $[^{13}C]CO_2$-containing atmosphere, thus allowing separation of semiconservatively replicated from unreplicated DNA. Measurement of $^{32}P_i$ incorporation into unreplicated parental DNA showed that no uv-dependent synthesis, i.e., repair replication, occurs in either the nuclear or chloroplast genomes of this organism. A peak of ^{32}P-labeled material appeared at a density midway between that of parental and hybrid DNA in samples actively synthesizing DNA. This replicative intermediate is found in both chloroplast and nuclear DNAs, and its presence is uv sensitive. This is consistent with the finding that uv-irradiation blocks normal DNA synthesis in Chlamydomas. Experiments on incorporation of radioactive precursors into cellular DNA showed that no pyrimidine base or nucleotide tested is efficiently incorporated. Thymidine, however, was incorporated specifically into chloroplast DNA, but the amount of incorporation was meager. The data presented here, that Chlamydomonas reinhardi does not excise pyrimidine dimers or perform repair replication, is consistent with the hypothesis that the organism lacks the dark-, or excision-repair mode of repairing uv-induced damage to its DNA. (Diss. Abstr. Int., B)

20002 BIOLOGICAL AND BIOCHEMICAL EFFECTS OF IRRADIATION ON LIVING SYSTEMS. Kovacik, A.; Jiracek, V.; Kryzanek, R. (Inst. of Genetics and Plant Breeding, Prague). Genet. Slechteni; 8: No. 4, I-XV(Oct 1972). (In Czech).

Recent knowledge on biological and biochemical effects of irradiation on living systems is described. Problems concerning the effect of irradiation on proteins, enzymes, as well as nucleic acids, general principles of radiation injuries of cells and their components are discussed. (auth)

Radiation Effects on Cells

Refer also to abstracts 20002, 20041, 20042, 20081, and 20181.

20003 (KURRI-TR-100) DEATH OF CELLS BY IONIZING RADIATION. Ikishima, R. (comp.) (Kyoto Univ. (Japan). Research Reactor Inst.). 1972. 56p. (In Japanese). Dep. NTIS (U. S. Sales Only).

The second seminar held at the Reactor Research University of Kyoto University entitled Death of Cells by Ionizing Radiation invited participation from young investigators. Seven papers are presented together with a summary paper. Six of these papers are provided with abstracts in English. The titles of the papers are DNA chain scission and death in microorganisms, DNA chain scission and death in mammalian cells, Chromosome aberration and mitotic block as related to cell death, SH radicals and cell death induced by ionizing radiations, Interference to membrane functions and death, Interference with energy metabolism and death, and Radiation induced damage to the cell in the mammalian cell renewal system. The series is concluded with the summary paper entitled What constitutes death-What do we look for to certify that death has occurred. (TTT)

20004 INHIBITION OF THYMINE DIMER EXCISION BY THE PHORBOL ESTER, PHORBOL MYRISTATE ACETATE. Teebor, G. W.; Duker, N. J.; Ruacan, S. A.; Zachary, K. J. (New York Univ., NY). Biochem. Biophys. Res. Commun.; 50: No. 1, 66-70 (4 Jan 1973).

The effect of the promoting agent, phorbol myristate acetate, on repair of uv-induced damage in HeLa cells was studied. The agent decreased survival and subsequent colony-forming ability of irradiated cells and inhibited removal of uv-induced thymine-containing dimers from DNA of irradiated cells. (auth)

20005 POLYPLOIDY INDUCED BY X-RAYS DURING THE CELL CYCLE OF CHINESE HAMSTER CELLS IN VITRO. Yu, C. K.; Sinclair, W. K. (Argonne National Lab., IL). Radiat. Res.; 52: No. 3, 509-519(Dec 1972).

Synchronized Chinese hamster cells in vitro were used to examine the stage dependence of the induction of polyploidy by x irradiation. The data obtained from various experiments, including cells that were in the G_1 and S stages of the cell cycle only, showed that polyploid cells can be induced only when they are irradiated in G_1. This finding is supported by autoradiographic studies, in which no induced polyploid cells were labeled with ^{3}HTdR, and by the fact that chromosome aberrations were observed only in these polyploid cells. (auth)

20006 INFLUENCE OF 5-BROMODEOXYURIDINE ON THE INDUCTION OF BREAKS IN THE DEOXYRIBONUCLEIC ACID OF CULTIVATED HUMAN CELLS BY X-IRRADIATION AND ULTRAVIOLET LIGHT. Lohman, P. H. M.; Bootsma, D.; Hey, A. H. (Medical Biological Lab. TNO, Rijswijk, Netherlands). Radiat. Res.; 52: No. 3, 627-641(Dec 1972).

The effect of the incorporation of 5-bromodeoxyuridine (BUdR) in the DNA of T cells on radiosensitivity after irradiation with x rays and with ultraviolet light was studied. Radiation survival decreased both after x ray and ultraviolet light. BUdR incorporation into T cells causes a lengthening of the cell cycle that could be attributed to selective increases of the G1 and S phases. This change in age distribution of the cells might slightly affect the radiosensitivity based on survival. The incorporation of BUdR during one generation cycle before x irradiation caused an increase in the induction of breaks in the 5-bromouracil (BU)-containing strand over those found in the opposite strand of DNA from the same cells. This increased break induction was found only after x irradiation and treatment with high concentrations of BUdR. The induction of breaks in both strands was always linear with dose. Irradiation with ultraviolet light produced practically no induction of breaks in normal T cells. After exposure of the cells to a relatively low concentration of BUdR during one generation cycle, irradiation with ultraviolet light produced a large number of breaks in the BU-containing strand but no increase in the opposite non-BU-containing strand of DNA. Break induction in the BU-containing DNA strand was found to be nonlinear with dose. No correlation could be found between the increased radiation-induced mortality and the increased number of primary-induced single-strand breaks in the BU-containing DNA strand. (auth)

20007 PROLONGED ULTRAVIOLET-INDUCED THYMIDINE INCORPORATION INTO XERODERMA PIGMENTOSUM LYMPHOCYTES: STUDIES ON ITS DURATION, AMOUNT, LOCALIZATION, AND RELATIONSHIP TO HYDROXYUREA. Robbins, J. H.; Kraemer, K. H. (National Institutes of Health, Bethesda, MD). Biochim. Biophys. Acta; 277: 7-14(Aug 1972).

Xeroderma pigmentosum lymphocytes, which have a lower than normal rate of ultraviolet-induced [^{3}H]thymidine incorporation during the hours immediately after irradiation, continue their incorporation for a longer time than normal lymphocytes. This difference in the duration of incorporation into xeroderma pigmentosum and normal lymphocytes is not caused by the continuous presence of hydroxyurea in the cultures. The prolonged incorporation ceases after the xeroderma pigmentosum lymphocytes have incorporated as much thymidine as normal lymphocytes. Autoradiograms show that the prolonged incorporation is nuclear and occurs in the majority of lymphocytes. The results indicate that these xeroderma pigmentosum lymphocytes can perform as much repair of ultraviolet-damaged DNA as normal lymphocytes but require a longer period in which to do so. (auth)

20008 MICROSPECTROPHOTOMETRIC EXAMINATIONS OF THE DNA-CONTENT IN PRIMARY AND METASTATIC MELANOMA FOCUSES BEFORE AND AFTER IRRADIATION. Avtondilov, G. G.; Golbert, Z. V.; Chervonnaya, L. V. Radiobiol.-Radiother.; 13: No. 6, 675-679(1972). (In German).

The DNA content in primary and metastatic melanoma focuses was examined by means of the microphotometric method before irradiation (11 primary melanomas and 8 of their metastases) and after irradiation (32 primary melanomas and 32 metastases). Before irradiation, a nonuniform distribution of the cells with respect to their DNA content was observed in these neoplasms. In the metastases there was a higher number of polyploid cells. After irradiation a higher therapeutical effect was found in the primary tumors. It is concluded that the biological properties in the tumor cells of primary and metastatic focuses are different and that their radiosensitivity depends on the ploid character of the tumor cells. (auth)

20009 RADIATION-INDUCED DIVISION DELAY. Miller, D. R. Fort Collins, CO; Colorado State Univ. (1972). 133p. University Microfilms Order No. 73-2806.

Thesis (Ph. D.).

Chinese hamster ovary (CHO) cells, synchronized by selecting mitotic cells, received 300 rads of x-radiation at various intervals during the cell cycle and were examined for cell number until they had completed their next wave of division. These growth curves were analyzed for division delay in relation to both types of media, i.e., modified Ham's F-10 or modified McCoy's 5a, and to culturing conditions, i.e., monolayer or suspension. Regardless of the type of media or culturing conditions used, mitotic cells were delayed somewhat longer (0.55 min/rad) than early G_1 cells, and then the delay increased with cell age from early-mid G_1 (0.32 min/rad) to late S-early G_2 (0.84 min/rad). Thus, radiosensitivity during the cell cycle approaches in late S phase a maximum for division delay in contrast to a minimum for cell killing and chromosomal aberrations. Furthermore, division delay was not increased by either incorporating bromodeoxyuridine into the DNA or treating the cells with hypertonic medium, although each of these treatments increased mortality and chromosomal aberrations by factors of 1.45 to 2.00. All of this evidence suggests that the site of action involved in x-ray-induced division delay differs from that involved in chromosomal aberrations and cell killing. The decay in initiation of DNA synthesis (S delay) was studied after irradiating cells in mitosis or at various points in G_1 with 150, 300, or 600 rads. Except for irradiation during mitosis, S delay observed for 600 rads was approximately equal to the time spent in G_1 when irradiation occurred (up to a maximum of 3 hours). Less S delay was found for lower doses, but the delay for 600 rads was probably a maximum because the literature indicates that delay increases with dose only up to 300 to 600 rads. When cells received 600 rads at 6 hours as they were initiating DNA synthesis, they continued to enter S at the normal rate for about 1.5 hours and then sustained a delay of only about 1 hour. Since these delays agree well with additional delays observed following inhibition of protein synthesis with cyclohexamide or puromycin, x-ray-induced delay in DNA synthesis may also be caused by an effect on initiator factors involving protein synthesis. (Diss. Abstr. Int., B)

20010 QUANTITATIVE STUDY OF THE EFFECT OF SINGLE AND SPLIT-DOSE X-IRRADIATION ON HeLa IN MONOLAYER

CULTURE. Siracka, E. (Cancer Research Inst., Bratislava). Neoplasma; 19: No. 5, 519-523(1972).

Confluent monolayer of HeLa cells was exposed to x irradiation doses similar to those used in the clinical practice. The purpose of the experiment was to study the dose response effects reflected by cell counts after the exposure given as a single dose, or split-dose applied in two equal fractions separated by 18 hrs. The changes in cell counts were followed for six days. When cell cultures were exposed to small dose range (50 to 200 R) given in two fractions, higher cell numbers were obtained than in cultures exposed to the same dose in a single exposure. On the other hand, after large doses (400 to 1000 R) when given in two fractions, the cultures exhibited lower cell counts than the cultures irradiated by the same single dose. These differences persisted for 6 days of observations but were statistically significant on the second day only. Observations made on the cell population after the exposure to radiation seem to be of interest for the study of the behavior of cell population in tissues and organs exposed to radiation therapy. (auth)

20011 DIFFERENCES IN LET DEPENDENCE OF CELL KILLING AND THE PRODUCTION OF HERITABLE NON-LETHAL DAMAGE IN MAMMALIAN SYSTEMS. Berry, R. J. (Churchill Hospital, Oxford). pp 89-98 of Radiobiological Applications of Neutron Irradiation. Vienna; International Atomic Energy Agency (1972).

From Meeting on radiobiological applications of neutron irradiation; Vienna, Austria (6 Dec 1971). See STI/PUB-325; CONF-711204.

Data are presented comparing the responses of murine P-388 leukemia cells after irradiation with monoenergetic track segments of beams of accelerated charged particles or with fast neutrons of different energies. Lethal radiation damage is measured by the inability of irradiated cells to proliferate to cause the death of isologous host mice into which known numbers of irradiated cells have been inoculated. Non-lethal damage is measured by the increase in the time taken for the smallest number of surviving tumour cells to cause the death of the isologous host mice, compared with the time taken from inoculation of a minimum number of unirradiated tumour cells to the death of the host animals. For radiations of high ionization density, and particularly for fast neutrons of all energies studied, there is a consistently greater relative biological effectiveness for the production of non-lethal radiation damage than for producing lethal damage. This difference is most marked when irradiation takes place under hypoxic conditions. (auth)

20012 RBE OF FAST NEUTRONS AS A FUNCTION OF DOSE, NEUTRON ENERGY, AND BIOLOGICAL END-POINT. Broerse, J. J.; Barendsen, G. W. (Radiobiological Inst. TNO, Rijswijk, Netherlands). pp 135-46 of Radiobiological Applications of Neutron Irradiation. Vienna; International Atomic Energy Agency (1972).

From Meeting on radiobiological applications of neutron irradiation; Vienna, Austria (6 Dec 1971). See STI/PUB-325; CONF-711204.

The relative biological effectiveness (RBE) of fast neutrons relative to 300-kV x rays depends on a variety of factors, including the type of effect considered and the conditions of the system investigated. The general characteristics of dose-effect relations are discussed for monoenergetic charged particles with a well-defined LET and fast neutrons, which have a complex distribution of dose in LET. Experimental results on the RBE as a function of dose and neutron energy are presented for a number of different effects in rodent tissues. (auth)

20013 IMPORTANCE OF USING FAST NEUTRONS TO CONFIRM PREDICTIONS MADE FROM EXPERIMENTS USING MONOENERGETIC PARTICLE BEAMS. Berry, R. J. (Churchill Hospital, Oxford). pp 203-9 of Radiobiological Applications of Neutron Irradiation. Vienna; International Atomic Energy Agency (1972).

From Meeting on radiobiological applications of neutron irradiation; Vienna, Austria (6 Dec 1971). See STI/PUB-325; CONF-711204.

It is possible to predict some, but not all of the parameters of biological response to fast neutrons of different energies from a knowledge of the response of the same biological system after irradiation with monoenergetic track-segments of beams of charged particles. An important effect of the irradiation geometry cannot be ignored. (auth)

20014 MOLECULAR THEORY OF CELL SURVIVAL. Chadwick, K. H.; Leenhouts, H. P. (Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen, Netherlands). Phys. Med. Biol.; 18: No. 1, 78-87(Jan 1973).

A theory is presented to explain the effect of radiation on cell survival. The theory is based on the assumption that a double-strand break in the DNA helix is the critical damage. The theory is derived from the radioinduced molecular bond breaks in the DNA strands and parameters are included to take account of various repair processes that may occur between the radiation event and the biological result. Implications of the theory with respect to RBE, the oxygen effect, and radiological protection are mentioned and a fit of the theoretically derived expression to experimental data for 250 kV_p x rays and 15-MeV neutrons is presented. An appendix contains data, which show that the enzymatic repair of single strand breaks in DNA is in accordance with the theoretical analysis of protracted irradiations and that a coherent analysis of the variation of radiation sensitivity in the cell cycle is in strong support of the primary assumption that a double strand break in the DNA helix is the critical damage leading to cell reproductive death. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 20094 and 20139.

20015 MEASUREMENTS OF PROTEOLYTIC ACTIVITY IN CHICKEN MEAT AND OF ITS EFFECTS ON SOLUBLE PROTEINS AFTER IONIZING IRRADIATION. Klein, W.; Altmann, H. (Oesterreichische Studiengesellschaft fuer Atomenergie, Seibersdorf). Kerntechnik; 14: No. 12, 582-583(Dec 1972). (In German and English).

The proteolytic activity in chicken breast and leg meat, measured by a hemoglobin method, and alterations of soluble proteins by enzymatic action after gamma irradiation of the meat up to various absorbed dose levels are reported. The effect of pasteurizing radiation doses on proteolytic activity is slight; the possibility of achieving increased stability in storage is therefore doubtful because enzymatic alterations of soluble proteins in the meat cannot be excluded. (auth)

20016 X-RAY-INDUCED DELAY OF CELL DIVISION IN SYNCHRONIZED TETRAHYMENA PYRIFORMIS. Hodge, F. A.; Nachtwey, D. S. (Oregon State Univ., Corvallis). Radiat. Res.; 52: No. 3, 603-617(Dec 1972).

X irradiation delays division of heat-synchronized Tetrahymena pyriformis (a ciliate protozoon) if exposure occurs prior to a critical time after the end of the synchronizing treatment (EST). Exposure after this critical time does not significantly delay the first synchronized division but does delay the second. The time of the transition from a state where the cells are delayed to one where they are not is somewhat dose dependent: within limits, the larger the exposure, the later is the transition time. The division delay response is always correlated with a resorption of the oral primordium of the presumptive posterior daughter cell. The amount of time for resorption varies with the time after EST at which the cells are irradiated and is dose dependent. The data are consistent with the hypothesis that irradiation produces damage during all parts of the synchronized cell cycle, but that, depending on the dose and the time of irradiation after EST, the damage may or may not trigger a response that leads to delay of the first division. (auth)

20017 X-RAY INACTIVATION OF BACTERIOPHAGES: ROLE OF O_2-DEPENDENT DAMAGE IN SINGLE- AND DOUBLE-STRAND DNA PHAGES. Freifelder, D.; Donta, S. T.; Goldstein, R. (Brandeis Univ., Waltham, MA). Virology; 50: No. 2, 516-519 (Nov 1972).

When the single-strand DNA phage, ϕX174, of Escherichia coli is x-irradiated in air, ca. 30% of the lethal hits are single-strand breaks and 70% are O_2-dependent alterations, likely to be base damage. Therefore, O_2-dependent damage is probably much more prevalent than was concluded from earlier studies with double-strand DNA phages. This O_2-dependent damage prevents x-irradiated λ phage from complementing λsus mutants. (auth)

20018 UV-INDUCED RECOMBINATION AND REPAIR OF PARENTAL LAMBDA BACTERIOPHAGES LABELED BY MEANS OF HOST-CONTROLLED MODIFICATION. Baker, R.M.; Haynes, R. H. (Univ. of California, Berkeley). Virology; 50: No. 1, 11-26(Oct 1972).

The uv-enhancement of λ bacteriophage recombination was examined utilizing parental phages labeled by means of host-controlled modification. Light uv-irradiation of λ phages infecting HCR^+ or HCR^- Escherichia coli bacteria causes similar absolute increases in the frequencies of recombinants among all progeny phages and among progeny that contain HCM-labeled–$\lambda \cdot$ K12(P1)–parental DNA strands. The uv-induced recombination

involves breakage and reunion of parental DNA strands. With increasing uv dose to the infecting phages there is a decrease in the relative yield of progeny that retain a parental HCM label. The HCM-labeled λ progeny recovered from multiple infections with uv-irradiated phages of excision-defective HCR^-, but not HCR^+, bacteria contain nearly as many host-cell reactivable uv lesions as the infecting phages; these HCM-labeled progeny probably contain mainly conserved parental DNA. The possibility that there may be a selection against recovery of semiconserved parental DNA from infections with uv-irradiated phages is discussed. UV-induced recombinations may be formed prior to replication of the infecting phage DNA. (auth)

20019 RESISTANCE OF FUNGI CONTAINING VARIOUS PIGMENTS TO GAMMA-IRRADIATION. Mirchink, T. G.; Kashkina, G. B.; Abaturov, Yu. D. (Moscow State Univ.). Mikrobiologiya; 41: No. 1, 83-86(1972). (In Russian).

Twenty-one strains of fungi lacking pigment or containing various pigments were tested for their resistance to gamma-irradiation under a cobalt lamp. The pigmentless strain Cephalosporium acremonium and Penicillium luteum containing yellow-orange pigment of noncarotenoid type were killed by 80 to 100 curie. Their LD_{50} dose was 10 to 25 curie. The red-violet fungi of Fusarium sp. had a similar LD_{50} (10 to 25 curie), but they were killed by doses over 100 curie, and some strains of this species were killed by doses exceeding 250 curie. Stemphylium botryosum containing black pigment was very resistant; 1.2 percent to 1.7 percent survived irradiation by 625 curie. The strains isolated from high mountain soil samples had LD_{50} around 180 curie, those from lowland plain soil around 140 curie. Alternaria tennis had a similar resistance of its strains isolated from mountain soil, but it was more sensitive in lowland soil (LD_{50} = 60 to 80 curie). However, fungi of the genus Cladosporium were less resistant, being killed by 625 curie. The presence of pigment usually increased the resistance to gamma-irradiation. The resistance of the strains within one species varied with the location from which the particular strains were isolated. (JPRS)

20020 CORRELATION BETWEEN THE DYNAMICS OF POST-IRRADIATION DEATH OF AMOEBA AND THE IRRADIATION DOSE. Bychkovskaya, I. B.; Ochinskaya, G. K. Tsitologiya; 14: No. 1, 137-140(1972). (In Russian).

Amoeba proteus, cultivated in individual lines, were irradiated with 190 kv x rays in doses ranging from 0.1 to 400 kR. The mortality of the cells was not strictly proportional to the dose. After 0.1 to 40 kR, 50% of the cells were dead in 40 days, and 85 to 100% were dead in 80 days, regardless of the dose. In non-irradiated controls, only 7% died in 80 days. In the middle range of 60 to 120 kR, the mortality rate increased with increasing doses. In the high range of 150 to 400 kR, the correlation was absent again; most cells died in 2 days, with only a few surviving up to the 8th day. Additional determinations revealed that the cells survived up to the 27th generation after low irradiation, up to the 7th generation after medium irradiation, and only one generation after high irradiation. The results indicate that, contrary to the prevailing belief, Amoeba proteus is very sensitive to x rays. (auth)

20021 SOME MICROBIOLOGICAL OBSERVATIONS ON CONSERVED TOMATOES AFTER GAMMA IRRADIATION. Magaudda, G.; Inghilesi, E. (CNEN, Rome). Agrochimica; 569-574(1972). (In Italian). (RT/BIO(72)38):

A different radiosensitivity between bacterial and fungal populations was observed in microbiological studies dealing with food irradiation carried out on some varieties of tomato. The most numerous species isolated were: Cladosporium, Alternaria, Stenphyllium, Fusarium, Penicillium and Botrytis. The development of the bacterial species was sufficiently controlled with gamma radiation doses up to 300 krads. These results are discussed in regard to their implications in the control mechanisms of proliferation and differentiation of haemopoietic stem-cells. (auth)

20022 EFFECTS OF ^{60}Co IRRADIATION ON AFLATOXIN PRODUCTION BY ASPERGILLUS FLAVUS GROWN ON WHEAT AND A SYNTHETIC MEDIUM. Applegate, K. L. Columbus, OH; Ohio State Univ. (1972). 135p. University Microfilms Order No. 73-1927.

Thesis (Ph. D.).

Studies were conducted to determine the effects of ^{60}Co irradiation on aflatoxin production by Aspergillus flavus NRRL-A-12268 and Aspergillus flavus NRRL-3145. The individual strains were initially grown at 28°C for 14 days on potato dextrose agar slants, the spores were removed by washing the slants with sterile distilled water and concentrated by centrifugation. The spore strains were independently exposed to varying doses of ionizing radiations ranging from 25 to 600 krad. Following irradiation the spores were inoculated on sterilized wheat and a synthetic medium (Czapek's). The inoculated test substrates were incubated at 28°C in 98 ± 2% relative humidity chamber within a rotory incubator for periods of from one to ten days. Single flasks of wheat and synthetic media representing a specific irradiation dose and Aspergillus strain (NRRL-3145 or NRRL-A-12268) were removed daily from day one through day ten from the relative humidity chamber of the shaker incubator. The contents of each flask were individually analyzed for aflatoxins B_1, B_2, G_1, and G_2. The four aflatoxins were individually separated from the purified wheat extract and primary extracts of the synthetic medium by thin-layer chromatography. Quantitative determinations of the individual aflatoxins (B_1, B_2, G_1, and G_2) were accomplished by scraping and vacuum collecting the purified aflatoxin spots from thin-layer chromatography plates. The final quantitative determinations were accomplished by comparing the optical density readings obtained from the extracted samples with those of known concentrations of the individual aflatoxins. Exposure of the nontoxinogenic A. flavus NRRL-A-12268 spores to 25, 50, 100, 150, 200, 300, 400, or 600 krad of ^{60}Co radiation did not induce the production of aflatoxins B_1, B_2, G_1, or G_2 by this organism on either wheat or synthetic medium. Spores of the toxinogenic organism A. flavus NRRL-3145, when exposed to gamma irradiation doses of 50, 150, 200, and 300 krad, developed in both wheat and synthetic medium into cultures producing larger amounts of aflatoxin than similar non-irradiated A. flavus cultures. The most notable increases in aflatoxin production were induced by exposing spores to 200 krad of gamma irradiation and incubating the cultures for seven days at 28°C. Exposure of A. flavus NRRL-3145 to 400 krad of ^{60}Co gammas resulted in complete inhibition of spore germination in both wheat and synthetic medium which consequently resulted in aflatoxin inhibition. (Diss. Abstr. Int., B)

20023 GENETIC CONTROL OF X-RAY RESISTANCE IN BUDDING YEAST CELLS. Benathen, I. A. New York; City Univ. of New York (1972). 124p. University Microfilms Order No. 73-2828.

Thesis (Ph. D.).

Five x-ray sensitive mutants were selected from 10,000 colonies surviving treatment with ultraviolet light. These mutants were named XS5, XS6, XS7, XS8, and XS9. X^s1 was donated by Nakai. These mutants fall into two phenotypic classes: class I in which budding confers no resistance, and class II in which resistance is detectable but subnormal. These mutants when crossed with one another show a complex complementation pattern. The heterozygous diploids composed of X^s1 and any other class I or class II mutant show only 50% remaining wild type budding cell resistance function, while all other heterozygous diploids show at least 70% of normal function. The reduced function of X^s1 heterozygotes was attributed to a gene dosage effect at this locus. The subnormal function in all other heterozygotes was attributed to either hybrid enzyme formation, which would lead to production of active as well as inactive enzyme aggregates, or to the presence of a leaky mutant. Incomplete dominance at the mutant loci was interpreted in the same manner. The genetic and radiation survival data support the following conclusions. No direct correlation between the presence or absence of sporulation and radiation sensitivity may be made. Genes that influence budding cell resistance do not influence meiotic genetic recombination. Sensitivity to radiation induction of recessive homozygosis in mutants is complex. Both coupling and noncoupling of resistance to lethal and non-lethal effects of radiation were observed. One mutant showing subnormal budding cell resistance is refractory to induction of the nonlethal alteration. One mutant, which lacks any budding cell resistance, is sensitive to induction of recessive homozygosis. The budding cell shoulder is under the control of a single gene. With the exception of the budding cell shoulder gene, there appears to be a direct correlation between the DMF (with reference to wild type of the budding cell survival) and that of the diploid interdivisional cell survival. Evidence was presented to show that the cellular processes conferring resistance to the lethal and nonlethal effects of ionizing radiation in yeast operate by means of repair of x-ray damage. Speculation concerning the genetic basis of the mechanisms involved in budding cell resistance were offered, in which sequential, parallel, and branching models for class I and class II gene organization were considered. It is proposed that the genes are organized either in a sequential pathway, or in a combination of sequential and branching pathways. (Diss. Abstr. Int., B)

20024 PLASTID ULTRASTRUCTURE OF THE WHITE AND YELLOW MUTANTS OF CHLAMYDOMONAS REINHARDI. Ladygin, V. G.; Semenova, G. A.; Tageeva, S. V. (Inst. of Biological Physics, Pushchino-on-Oka, USSR). Tsitologiya; 14: No. 12, 1455-1460(Dec 1972). (In Russian).

White and yellow mutants were obtained by γ irradiation of a unicellular alga Chlamydomonas reinhardi. The white mutant

plastid of this alga is shown to have a reduced lamellar system similar to that of higher plant ethyoplasts. The yellow mutant plastid membrane system is reduced to a lesser degree. Single thylakoids and a great number of vesicles (the main components of plastid membrane structure) are formed in plastids in the darkness. In the yellow mutant plastid, the formation of promellar body is revealed in the darkness. In the light, the chloroplast ultrastructural organization of this mutant does not practically differ from the control one due to the restoration of normal biosynthesis of chlorophyll. A conclusion was drawn that the mechanism of chloroplast lamellar structure formation of the green algae does not differ from that of higher plants. (auth)

20025 SURVIVAL OF ACHOLEPLASMA LAIDLAWII A AND CHANGES IN ITS DNA AFTER IRRADIATION WITH X- AND GAMMA RAYS. Drasil, V.; Hutkova, J.; Liska, B. (Inst. of Biophysics, Brno). Folia Biol. (Prague); 18: No. 6, 424-433 (1972).

The survival curves of A. laidlawii A irradiated with x rays or gamma rays show a D_0 value around 5,000 rad for exposure in the presence of oxygen, and 19,000 to 20,000 rad for irradiation with oxygen removed. Incubation of the irradiated cells results in an enzymatic degradation of DNA. This process displays the same oxygen enhancement ratio as that found for survival curves. The nature of the degradation products of enzymatic DNA cleavage indicates that an essential role in the degradation process is played by some of the exonucleases. The enzymatic degradation of irradiated DNA prevents an exact estimation of the number of single breaks induced by radiation. The number of single breaks in A. laidlawii A DNA decreased several times, when the irradiation was carried out in the absence of O_2. The effect can probably be attributed to enzymatic DNA degradation rather than to a decrease in DNA radiation sensitivity due to oxygen absence. No repair of radioinduced single breaks was observed in irradiated A. laidlawii A cells incubated in nutritive medium. (auth)

20026 INFLUENCE OF ENERGY METABOLISM ON THE REPAIR OF X-RAY DAMAGE IN LIVING CELLS. II. Split-dose Recovery, Liquid-Holding Reactivation and Division Delay Reversal in Stationary Population of Yeast. Jain, V. K.; Pohlit, W. (Gesellschaft fuer Strahlen und Umweltforschung, Munich). Biophysik; 9: No. 2, 155-165(1973).

Split-dose recovery (SDR), liquid-holding reactivation (LHR), and division delay reversal (DDR) in x-irradiated stationary cell populations of Saccharomyces cerevisiae were investigated in buffer and in the presence of glucose. In buffer, all the three recovery phenomena showed sigmoid type of kinetics but with some quantitative differences. DDR was completed in relatively shorter time as compared to LHR or SDR. The time needed for the completion of LHR and SDR was about the same but LHR showed a longer lag time. LHR and DDR depended on temperature in a similar way. On adding glucose to the medium, an increase in the rate of LHR, a delay in the onset of SDR, and a transient increase in the radiation sensitivity after the irradiation were observed. (auth)

20027 SURVIVAL, MUTATION, AND CAPACITY TO REPAIR SINGLE-STRAND DNA BREAKS AFTER GAMMA IRRADIATION IN DIFFERENT EXR$^-$ STRAINS OF ESCHERICHIA COLI. Sedgwick, S. G.; Bridges, B. A. (Univ. of Sussex, Brighton, Eng.). Mol. Gen. Genet.; 119: No. 2, 93-102(1972).

Strains of Escherichia coli K-12 and B/r made by transduction of the exrA allele from a B_{s-2} derivative were compared with Exr(W)$^-$ strains derived from B_{s-1} and B_{s-2} by mutation (E. M. Witkin, 1967). Both transduced exrA and Exr(W)$^-$ strains were almost unmutable by gamma radiation, but the former class was as sensitive to gamma radiation as recA strains and, like them, were unable to repair single-strand DNA breaks as detected by the McGrath-Williams technique. In contrast the Exr(W)$^-$ strains were as resistant to gamma radiation as Exr(W)$^+$ strains derived from them and were equally efficient in repairing single-strand breaks. The existence of Exr(W)$^-$ strains suggests that the mutagenicity of single-strand breaks may depend entirely on the way in which they are repaired. The properties of the (Exr(W)$^-$ strains cannot be ascribed solely to the transducible exrA allele. A large effect of diffuse daylight in lowering the molecular weight of DNA on alkaline sucrose gradients is described which, unless prevented, may lead to erroneous results in such experiments. (auth)

20028 PROPHAGE INDUCTION AND CELL DIVISION IN E. COLI. II. Linked (recA, zab) and Unlinked (lex) Suppressors of tif-1-Mediated Induction and Filamentation. Castellazzi, M.; George, J.; Buttin, G. (Institute de Biologie Moleculaire, Paris). Mol. Gen. Genet.; 119: No. 2, 153-174(1972).

The pleiotropy of tif-1, a mutation in E. coli K12 causing, among other effects, cellular filamentation at 42°C and thermal induction of lysogenic derivatives, can be explained by the participation of the tif$^+$ gene product in more than one reaction pathway. Pathways that involve the tif$^+$ product may be analyzed by selection of secondary mutations that reverse both tif-1-mediated prophage induction and cell filamentation. Among revertants of a tif-1 lysogen among 20% are recombination deficient. These appear to carry a recA mutation. In addition to this class is a rarer (7%) phenotypically distinguishable class of revertants, called zab, first described here. Markers tif-1, recA and zab are closely linked. Mutations lex that are dominant and located near malB also appear (3%) among tif-1 revertants. The lex$^+$ function is needed for normal uv, x-ray and mitomycin C induction of prophage λ. The zab mutation resembles recA in causing high sensitivity to uv, x-rays and mitomycin C, drastic DNA degradation following uv irradiation but normal capacity to repair uv-damaged infecting phage (Hcr$^+$), failure to carry out uv reactivation and uv mutagenesis of uv-irradiated bacteriophage λ, a markedly reduced level of spontaneous induction of λ. In contrast, other capacities, strikingly diminished by recA, are affected less, if at all by zab. Thus zab permits 30–60% normal recombination proficiency, shows real, although very low inducibility of λ by uv or mitomycin C, permits 100% efficiency of plating of λ red gam, and does not degrade DNA spontaneously. The hypothesis is proposed that the tif-1 mutation is a regulatory mutation controlling the activity, or more likely the synthesis, of repair enzyme(s). The level of these repair enzyme(s), rather than DNA lesions, may govern the stability of the prophage repressor and the capacity of the bacteria to form septa. (auth)

20029 INTRAUTERINE PESSARIES STERILIZED BY IRRADIATION. Molnar, I. (Textilipari Kutato Intezet, Budapest); Szego, E.; Joo, S. Izotoptechnika; 15: No. 10, 515-517(Oct 1972). (In Hungarian).

The technology involved in the γ-ray sterilization of intrauterine pessaries is discussed. Two years' experience in large-scale production is reviewed. (ERB)

20030 MORPHOLOGY OF NORMAL AND ABERRANT MURINE TYPE LEUKEMIA VIRUS AND ITS RELATIONSHIP TO RIBOSOMES. Tahmisian, T. N.; Ainsworth (Argonne National Lab., IL). pp 274-275 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

20031 GERM-KILLING IN BIOCHEMICAL PRODUCTS BY A GAMMA-IRRADIATION TECHNOLOGY. Hangay, G. (Kobanyai Gyogyszerarugyar, Budapest); Bartha, T.; Janovszky, I.; Gere, P.; Kuti, L. Izotoptechnika; 15: No. 10, 526-30(Oct 1972). (In Hungarian).

A correlation is established between the specific number of bacteria surviving in several biochemical products and the γ-ray doses absorbed. (ERB)

Radiation Effects on Plants

Refer also to abstract 20071.

20032 EFFECT OF γ-RADIATION ON THE BIOSYNTHESIS OF CAROTENOIDS IN THE TOMATO FRUIT. Villegas, C. N.; Chichester, C. O.; Raymundo, L. C.; Simpson, K. L. (Univ. of Rhode Island, Kingston). Plant Physiol.; 50: No. 6, 694-697 (Dec 1972).

Fruits of the lutescent tomato genetic line were exposed to γ-radiation at different stages of maturity to determine the effect of ionizing radiation on carotenoid synthesis in the ripening fruit. Irradiation generally resulted in the inhibition of carotenogenesis. The effect was more pronounced at the higher dosage and in less mature fruit. Lycopene synthesis was inhibited more extensively than β-carotene synthesis. The total carotenoid content was also generally lower in irradiated fruits. It was proposed that the β-carotene in the tomato fruit is formed by a pathway not involving lycopene. (auth)

20033 INFLUENCE OF ^{60}Co GAMMA RADIATION ON THE ACTIVITY OF ATP-ASE IN ROOTS OF MAIZE: AND THE PROTECTIVE EFFECTS OF GIBBERELLIN. Zikiryaeva, S. A.; Kasymov, A. (Tashkent State Univ.). Uzb. Biol. Zh.; No. 6, 18-20(1972). (In Russian).

The protective action of gibberellin on the ATPase activity of irradiated corn seedlings was investigated. Seven-day seedlings of corn and corn seeds were given 25 and 50 kR doses of gamma radiation. A 0.002% solution of gibberellin treatment

was administered to the seeds prior to irradiation, and to the plants after irradiation. The enzyme activity in the roots of irradiated plants (25 kR) without gibberellin treatment decreased about one and one-half times (and about three times for 50 kR); in those with gibberellin treatment the enzyme activity remained unaffected by radiation. (KSW).

20034 INFLUENCE OF GAMMA RADIATION ON THE RHYTHM OF POLLEN DEVELOPMENT. Kamalova, G. V. (Inst. of Experimental Plant Biology, Kiev). Uzb. Biol. Zh.; No. 5, 55-56 (1972). (In Russian).

Dry cotton seeds (G. hirsutum variety 108-F) and seeds of M. silvestris were given 1, 3, 10, and 20 kR of gamma radiation (source not specified) and then allowed to sprout and mature. The pollen of plants of cotton variety 108-F possessed certain chromosome anomalies detected during tetrad formation; diads or triads were encountered in rare cases. The larger doses of radiation produced a larger number of anomalies. Deviations from the norm were not observed in the case of M. silvestris. (KSW)

20035 EFFECTS OF X RAYS AND ELEVATED TEMPERATURE ON THE REGENERATION OF TRADESCANTIA CUTTINGS. Babayan, R. S.; Airapetyan, R. B. (Lab. of Induced Plant Mutagenesis, Erevan). Biol. Zh. Arm.; 25: No. 3, 40-45(Mar 1972). (In Russian).

Changes in the foot-forming ability of Tradescantia cuttings under the influence of x-radiation and elevated temperatures were studied. Cuttings with 3 to 4 leaves and 7 to 10 cm long were exposed to x-radiation in such a manner that either apical or basal parts were irradiated at doses of 3,000 to 4,000 R. Apical irradiation stimulated root formation, but irradiation of the entire cutting suppressed it. Thermal treatment of the basal portion had a stimulating effect. The two opposing tendencies suggest different mechanisms in operation for radiation and heat effects, respectively. (KSW)

20036 ONE PARTICULAR TYPE OF ABNORMAL MORPHOGENESIS ARISING FROM THE GAMMA IRRADIATION OF ACETABULARIA MEDITERRANEA. Bonotto, S.; Kirchmann, R. (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). G. Bot. Ital.; 106: No. 1, 21-27(1972). (In French).

The unicellular marine alga Acetabularia mediterranea constitutes an excellent material for radiobiological research. It was found that gamma radiation (^{60}Co) interferes with the morphogenetic process by producing several types of abnormal morphological differentiation. It is shown that whorl modification, one of the most interesting radioinduced anomalies, takes place both in whole and anucleate cells and that it is a dose dependent phenomenon. (auth)

20037 MUTAGENIC EFFECT OF X RADIATION AND ETHYLENIMINE ON M_2 SOFT WHEAT. Avakyan, V. A.; Amirbekyan, V. A. (Lab. of Induced Plant Mutagenesis, Erevan). Biol. Zh. Arm.; 25: No. 2, 34-39(Feb 1972). (In Russian).

The effect and specificity of action of x rays and ethylenimine on four varieties of soft wheat (T. aestivum) were studied. Wheat seed was x-irradiated in doses of 5, 10, 15, and 30 kR, and treated with 0.02 and 0.05% concentrations of ethylenimine for 18 hr. The action of x radiation on the variety Artashat produced 1.7 times as many mutants as the two concentrations of ethylenimine; for three other varieties, the difference was approximately the same as for Artashat. (KSW)

20038 COMPREHENSIVE REPORT ON THE NEUTRON IRRADIATION FACILITIES AND THE DOSIMETRY SYSTEM USED IN THE SEED-IRRADIATION PROGRAM. Casta, J. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Seibersdorf, Austria). pp 9-25 of Radiobiological Applications of Neutron Irradiation. Vienna; International Atomic Energy Agency (1972).

From Meeting on radiobiological applications of neutron irradiation; Vienna, Austria (6 Dec 1971). See STI/PUB-325; CONF-711204.

One of the primary goals of the coordinated program on the use of neutrons for seed irradiation was the introduction of standardized neutron irradiation facilities at reactor centres, suitable for biological materials and especially for seeds of crop plants. Three types of irradiation facility were designed and constructed. The first one, called standard neutron irradiation facility (SNIF), is used in swimming pool reactors; the second, called standard TRIGA irradiation facility (STIF), is used in TRIGA reactors; and the third, which can be used in the thermal columns of various research reactors, is called standard thermal column irradiation facility (SCIF). These facilities provide a rather homogeneous radiation field of fast neutrons with a relatively low background radiation of gamma rays and thermal neutrons for irradiation of biological material. Taking into account the relative biological efficiency (RBE) of fast neutrons, the contribution of gamma radiation and thermal neutron irradiation to the total dose equivalent of a seed irradiation in such a facility is approximately 1 to 5%, depending on the distance of the facility from the reactor core. The dose rate of fast neutrons and gamma radiation are measured routinely with two ionization chambers, one of which is sensitive both to fast neutrons and gamma radiation, the other being sensitive to gamma radiation only. The flux density and the fluence of fast neutrons are monitored by sulfur pellets for each irradiation in order to reduce errors due to inaccuracies in irradiation time, irradiation position and reactor power. A comparison of the dosimetry system used in this coordinated program with the dosimetry system of the HPRR in Oak Ridge was made and showed excellent agreement. (auth)

20039 USE OF A STANDARDIZED BIOLOGICAL SYSTEM TO COMPARE FAST NEUTRON FLUXES IN DIFFERENT REACTORS. Brunner, H.; Mikaelsen, K.; Luse, R. A. (International Atomic Energy Agency, Vienna). pp 81-7 of Radiobiological Applications of Neutron Irradiation. Vienna; International Atomic Energy Agency (1972).

From Meeting on radiobiological applications of neutron irradiation; Vienna, Austria (6 Dec 1971). See STI/PUB-325; CONF-711204.

Accurate estimates of fast neutron doses can be obtained by measuring the reduction of seedling height after seed irradiation. This criterion was adapted as a basis for a standard biological monitor. Barley seeds of the variety Himalaya CI 000620 were irradiated in Standard Neutron Irradiation Facilities in six different reactors as a part of an IAEA program of coordinated research. Neutron doses giving 50% growth reduction (D_{50}) in irradiated barley seedlings showed excellent agreement and reproducibility in these facilities and in other fast neutron sources. The value of the conversion factor relating the neutron dose in rads to the equivalent fission fluence has been determined and found to agree well with that determined in other reactor centres. (auth)

20040 RBE STUDIES USING THE TRADESCANTIA STAMEN HAIR TEST SYSTEM. Sparrow, A. H.; Underbrink, A. G. (Brookhaven National Lab., Upton, NY). pp 169 of Radiobiological Applications of Neutron Irradiation. Vienna; International Atomic Energy Agency (1972).

From Meeting on radiobiological applications of neutron irradiation; Vienna, Austria (6 Dec 1971). See STI/PUB-325; CONF-711204.

Tradescantia inflorescences were irradiated with 0.43-MeV monoenergetic neutrons in doses of 10 millirads to 8 rads and with 250-kVp x rays in doses of 250 millirads to 100 rads. Stamen hairs were examined at intervals for induced mutations. RBE was found to increase as dose decreased. For most aberrant cell types the x-ray curves had slopes appreciably greater than 1 in the dose range of 5 to 100 rads. In another series of experiments using monoenergetic neutrons ranging from 0.06 to 13.4 MeV it was found that 0.43-MeV neutrons gave the highest RBE and that energies either above or below 0.43 MeV were less effective relative to x rays. (HLW)

20041 RELATIVE BIOLOGICAL EFFECTIVENESS OF DIFFERENT KINDS OF NEUTRONS FOR CHROMOSOMAL ABERRATIONS. Moutschen, J. H. (Univ., Liege). pp 171-85 of Radiobiological Applications of Neutron Irradiation. Vienna; International Atomic Energy Agency (1972). (In French).

From Meeting on radiobiological applications of neutron irradiation; Vienna, Austria (6 Dec 1971). See STI/PUB-325; CONF-711204.

In calculating RBE it is of importance first to define the parameters on which the analysis of chromosomal aberrations is based. The stability of the biological materials is stressed with special reference to synchronization of cell populations and statistical control of the data. In this respect data obtained in recent experiments after treatments of Nigella seeds with various kinds of neutrons (fission, monoenergetic from 0.43 to 1.8 MeV, intermediate and thermal neutrons) are described and compared with those obtained with other plant and animal materials. These data have proved that RBEs have to be calculated separately in the case of each kind of aberration with different genetic implications, especially for the chromosome versus the chromatid class and one break versus two breaks. It is proposed to calculate RBEs of different radiations in comparison with the most reproducible neutron experiments. Monoenergetic neutrons of maximum RBE (i.e., 0.43 MeV) near the optimum LET show the greatest linear part of the dose-response curve and the lowest variability of response for all kinds of radiations. After the definition of the linear term of the curves in the case of each kind of radiation in completely standardized experiments, the values of extrapolated

RBEs at low doses and the saturation effects at high doses are analyzed and discussed. (auth)

20042 INFLUENCE OF TEMPERATURE AND OXYGEN ON CHROMOSOMAL ABERRATIONS DURING STORAGE OF FAST NEUTRON-IRRADIATED BARLEY SEEDS. Stoilov, M. (Inst. of Genetics and Plant Breeding, Sofia); Filev, K.; Troshev, T. pp 187-91 of Radiobiological Applications of Neutron Irradiation. Vienna; International Atomic Energy Agency (1972).

From Meeting on radiobiological applications of neutron irradiation; Vienna, Austria (6 Dec 1971). See STI/PUB-325; CONF-711204.

Seeds from the Himalaya barley variety containing 11% moisture were irradiated at the Standard Neutron Irradiation Facility with doses of 600, 1000, 1400, and 1800 rads. Part of the seeds were allowed to germinate immediately after irradiation, the rest were stored for 30 days as follows: in air at −5°C; in air at 20°C, and in nitrogen at 20°C. Anaphase analyses of the chromosomal aberrations indicate that storage of seeds in air for 30 days at 20°C results in an average increase in chromosomal aberrations of 5 to 6%, whereas storage at −5°C results in a decrease in the chromosomal aberration rate by the same percentage, the differences being statistically significant at the 5% level. Some differences were also observed between the series germinated immediately after irradiation and those stored in a nitrogen atmosphere, these differences being, however, statistically nonsignificant. The differences observed between seeds stored in air at 20°C and in nitrogen are also nonsignificant. Consequently, it may be concluded that there is no oxygen effect. It seems likely that the high storage temperature is somehow relevant to the full development of the potential damage and the low storage temperature to repairing part of it. (auth)

20043 USE OF NEUTRONS IN PLANT BREEDING. Sigurbjoernsson, B. (Joint FAO/IAEA, Vienna). pp 229-31 of Radiobiological Applications of Neutron Irradiation. Vienna; International Atomic Energy Agency (1972).

From Meeting on radiobiological applications of neutron irradiation; Vienna, Austria (6 Dec 1971). See STI/PUB-325; CONF-711204.

A brief review is presented of the advantages of neutron irradiation of seeds in plant breeding programs and the development of a Standard Neutron Irradiation Facility designed exclusively for seed irradiation in swimming-pool type reactors is discussed. Advantages of neutrons in producing different kinds of mutations are pointed out and the development of different varieties of crop plants such as barley, castor beans, oats, soybeans, and wheat is discussed. (HLW)

20044 MUTATIONAL EFFICIENCY OF EMS AS COMPARED WITH THAT OF GAMMA IRRADIATION IN LENS ESCULENTA (Moench.). Uhlik, J. (Univ. of Agriculture, Prague). Genet. Slechteni; 8: No. 4, 251-260(Oct 1972). (In Czech).

Findings concerning the mutational efficiency of ethyl methanesulfonate (EMS) and gamma irradiation in lentil are presented. The highest proportion of segregating M_2 offsprings comprising chlorophyll mutants and chimeric plants in the case of EMS and gamma irradiation amounted to 29.7 and 20.0%, respectively. Offsprings segregating simultaneously two or more kinds of chlorophyll mutants occurred after chemomutagen application and gamma irradiation in rather similar frequencies (4.2 and 4.0% of the offsprings, respectively). The number of mutant-types as well as their combinations, which were induced by both mutagens, was found to be dependent on the efficiency of experimental doses. As a result of gamma irradiation, and EMS treatment, the offsprings segregated simultaneously in maximum two and three different kinds of mutants, respectively. The highest number of chlorophyll mutants per one offspring achieved in the case of EMS treatment was 0.51, while in the case of gamma irradiation it was only 0.36. The highest number of chlorophyll mutants per 100 seed drilled achieved after EMS application and gamma irradiation was 2.36 and 0.56 of mutant, respectively. Maximal mutational efficiency was always higher in the case of EMS application than after irradiation. The lentil seeds of the variety "Hrotovická" were influenced in the range from 0.125 to 0.250% by EMS solutions after 20 hr at 18 to 20°C with a 45 min washing out. (auth)

20045 GENETICHESKIYE EFFEKTY PROMEZHUTOCHNYKH NEYTRONOV. (Genetic Effects of Intermediate Neutrons). Troitskii, N. A.; Turbin, N. V.; Arsen'eva, M. A. Minsk; Nauka i Tekhnika (1971). vp.

Data are presented on the genetic effectiveness of neutrons with an average energy of 200 keV, as compared with the effect of gamma rays and fast neutrons. The question of biological effects of elastic nuclear collisions is examined and the corresponding experimental data are given. The relationship between the genetic effectiveness of neutrons and biophysical parameters of irradiation, and, in particular, linear energy losses, are discussed. The book is intended for specialists in the field of radiation biology and genetics. (JPRS)

20046 INDUCTION OF XANTHA MUTANTS IN RICE BY IONIZING RADIATION. Majumdar, B. (Bose Inst., Calcutta). Indian J. Agr. Sci.; 5: No. 2, 123-124(1971).

To induce Xantha mutations in rice, 4 varieties viz. Dular, Marichbati, Jhanjee, and Sattka were treated with x rays and radioactive phosphorus. X rays were more effective than radioactive phosphorus. All the varieties responded differently to the radiations. Frequency of mutations increased with increased dosages of both. Dular variety was most sensitive. (Indian Sci. Abstr.)

20047 EFFECT OF GAMMA IRRADIATION ON CAROTENOID SYNTHESIS AND COLOR DEVELOPMENT IN TOMATOES. Baraldi, D. (CNEN, Rome). Agrochimica; 556-562 (1972). (RT/BIO(72)36).

Tomatoes (cultivar Supermarmande) irradiated at two different stages of maturity, with doses of 150 and 250 krad, and then stored at room temperature, showed a marked decrease in color development. The biosynthesis of lycopene and β-carotene was delayed a great extent in the irradiated sample for more than 10 days. Chlorophyll and phaeophytin were present in a higher amount in the irradiated tomatoes: they disappeared within 10 days in the control sample but were still present in the irradiated sample. Lutein seemed not to be affected by the given doses. The delay of ripening in tomatoes was greater when irradiation was carried out at the green stage of maturity. (auth)

20048 VLIYANIYE MAGNITNYKH POLEY NA BIOLOGICHESKIYE OBYEKTY. (Effect of magnetic fields on biological objects). Kholodov, Yu. A. (ed.). Moscow; Izdatel'stvo Nauka (1971). 216p.

A separate abstract was prepared for one chapter of the book. Eleven additional chapters discuss various aspects of effects of magnetic fields. (HLW)

For an abstract of an individual chapter see: 20049.

20049 EFFECT OF A MAGNETIC FIELD ON RADIATION-INDUCED CHROMOSOME ABERRATIONS IN PLANTS. Pozolotin, A. A. pp 89-97 of Vliyaniye Magnitnykh Poley na Biologicheskiye Obyekty. Kholodov, Yu. A. (ed.). Moscow; Izdatel'stvo Nauka (1971). (In Russian).

During an investigation of the effect of pulsed and constant magnetic fields on radioinduced chromosome aberrations in the meristematic tissue of the pea plant, a change was noted in the yield of aberrations caused by gamma irradiation of the root tips. The effect manifests itself only in the stage at the end of moistening irradiated seeds and depends on the dose of preliminary radiation. The effect is not uniform over the period of the first mitosis, from which it follows that the magnetic field affects the rate at which initial potential chromosome damage is restored. The results obtained confirm the conclusions that a magnetic field is a weak biological stimulus. (JPRS)

20050 MUTAGENEZ RASTENII. VYPUSK 1. (Mutagenesis of plants. Number 1). Gulkanyana, V. O. (ed.). Erevan; Izdatel'stvo Akademii Nauk Armyanskoi SSR (1971). 112p.

Separate abstracts were prepared for the 14 papers presented in the book. (ERB)

For abstracts of individual papers see: 20051 through 20064.

20051 JOINT EFFECT OF X-RAYS AND HIGH TEMPERATURE ON WHEAT SEEDS. Babayan, R. S. pp 5-13 of Mutagenez rastenii. Vypusk 1. Gulkanyana, V. O. (ed.). Erevan; Izdatel'stvo Akademii Nauk Armyanskoi SSR (1971). (In Russian).

Wheat seeds of Ukrainka, Artashati 42, and Erinaceum varieties were studied, after treating them for 10 to 15 min under the joint effect of both x rays and biological, superoptimal temperatures. Dry and sprouting seeds were treated with both stimulant and suppressive x-ray doses. Studies showed that preirradiation thermal treatment at 50 to 80°C for dry seeds and 45 to 50°C for seeds previously wetted has a protective effect on growth and fruit bearing. Earlier treatment of dry seeds with a temperature of 40°C increased the suppressive effect of x rays. Thermal treatment after irradiation, unlike preirradiation treatment, had a suppressive effect on growth and fruit bearing. No change of effect was observed from either the preceding or succeeding thermal treatment when 1500 and 5000 R x-ray growth stimulant doses were applied. (auth)

20052 NATURE OF THE CRACKING OF HYBRIDS OF WHEAT AND THE FREQUENCY OF OBTAINING MUTATIONS UNDER IRRADIATION. Avakyan, V. A. pp 14-21 of Mutagenez rastenii.

Vypusk 1. Gulkanyana, V. O. (ed.). Erevan; Izdatel'stvo Akademii Nauk Armyanskoi SSR (1971). (In Russian).

Studies were carried out on the genetic effect of x irradiation on hybrids of wheat. When the first hybrid generation of seeds was x-irradiated the dominant features were inclined to change in the second generation. Hybrid plants showed a higher mutability in comparison with the original ones. Their mutability spectrum was wider. The data obtained might present a basis for the conclusion that the combination of x irradiation and hybridization is a prospective method in the experimental mutagenesis of plants. (auth)

20053 EFFECT OF X-RAYS ON THE GROWTH AND FRUIT BEARING OF TRANSPLANTED WHEAT. Avakyan, V. A.; Babayan, R. S. pp 22-27 of Mutagenez rastenii. Vypusk 1. Gulkanyana, V. O. (ed.). Erevan; Izdatel'stvo Akademii Nauk Armyanskoi SSR (1971). (In Russian).

In the transplanted seeds of Ukrainka, Artashati 42, and Erinaceum wheat varieties either only the embryo, or only the endosperm or the whole sperm was treated with 5 and 20 kR x-ray doses. This was done through graftings of the appropriate parts following the irradiation of seeds. These experiments showed that it is mainly the embryo of the seeds that is affected by the irradiation. The irradiated endosperm also affects the growth and fruit bearing of the engrafted embryo. Effect of the irradiated endosperm on the embryo is probably due to the metabolites deviating from the normal course and penetrating into the cells of the embryo from the endosperm. (auth)

20054 CONCERNING SOME MUTANTS OBTAINED FROM THE ARTASHATI-42 WHEAT VARIETY UNDER THE JOINT EFFECT OF HIGH TEMPERATURE AND X RAYS. Babayan, R. S. pp 28-32 of Mutagenez rastenii. Vypusk 1. Gulkanyana, V. O. (ed.). Erevan; Izdatel'stvo Akademii Nauk Armyanskoi SSR (1971). (In Russian).

Description is given of 10 mutant forms obtained from the Artashati 42 wheat variety. Observation of the inheritance of the changing features of mutants was carried out up to the fourth generation. Through the joint effect of x rays and previous thermal treatment (70 to 80°C for 30 min) some of the changes that occurred belong to morphological and biological features, while others are in the limits of specific and nonspecific ones. The Artashati 42 wheat variety acquires a rather large spectrum of inheritable mutability by means of the mutagen effect. Some of these mutants could be of interest for selection purposes. (auth)

20055 EFFECT OF X-RAYS ON THE DEVELOPMENT OF HYBRIDS OF WHEAT. Avakyan, V. A. pp 33-38 of Mutagenez rastenii. Vypusk 1. Gulkanyana, V. O. (ed.). Erevan; Izdatel'stvo Akademii Nauk Armyanskoi SSR (1971). (In Russian).

Studies were carried out on the first generation of plants of inter-species and in-species hybrids of wheat, the maternal forms of which were obtained by seeds affected by x rays. It was noted that the crossing of maternal plants irradiated by a 10 kR dose of x rays with the nonirradiated paternal form leads to an increase in the amount of kernels and absolute weight of seeds of the hybrid plants. The essential difference of radiostability between the first generation of inter-species and in-species hybrid plants was elucidated. The stimulating effect of irradiation in the inter-species hybrid plants is more strongly felt. The hybrids obtained by the irradiated maternal form are characterized by the instability and high mutability of their dominant features. (auth)

20056 COMPARATIVE STUDY OF THE RADIOSENSITIVITY OF HYBRID SEEDS OF WHEAT. Avakyan, V. A.; Shakaryan, Zh. O.; Akopyan, A. Z. pp 39-44 of Mutagenez rastenii. Vypusk 1. Gulkanyana, V. O. (ed.). Erevan; Izdatel'stvo Akademii Nauk Armyanskoi SSR (1971). (In Russian).

Results of the comparative study of the radiosensitivity of the first, second, and third generation of hybrids of wheat plants, as well as parental forms is discussed. Plant species of the intermediate hybrids of the second and third generations compared with the parental forms have higher stability with regard to x rays. There is an essential difference in the radiosensitivity of hybrids obtained from different combinations. The genetic features of the parental forms play an important part in bringing out the radiosensitivity of hybrids. (auth)

20057 CONCERNING THE INCREASE OF THE STABILITY OF SEEDS BY MEANS OF THE THERMAL TREATMENT. Babayan, R. S. pp 45-51 of Mutagenez rastenii. Vypusk 1. Gulkanyana, V. O. (ed.). Erevan; Izdatel'stvo Akademii Nauk Armyanskoi SSR (1971). (In Russian).

When seeds of wheat and barley plants undergo a short-term (up to 30 min) high thermal treatment (70 to 80°C), their stability increases in relation to ionizing irradiation. Experiments were conducted to determine the supposed increase in the stability of seeds in relation to ionizing irradiation, which is a special case in showing the reactive increase of stability under the effect of heating. To verify this, the seeds after thermal treatment were also affected by some different factors (ethylenimine, hydroxylamine, alcohol, acetone, etc.). The data obtained show that the stability of seeds increases by means of the thermal treatment even under those factors too. Thus, it might be concluded that seeds with thermal treatment increase their overall stability without having any specific nature that might probably be the result of conformation changes of proteins. (auth)

20058 CONCERNING THE PROTECTIVE EFFECT OF THE SHORT-TERM HEATING OF WHEAT SEEDS UNDER IRRADIATION. Babayan, R. S. pp 52-58 of Mutagenez rastenii. Vypusk 1. Gulkanyana, V. O. (ed.). Erevan; Izdatel'stvo Akademii Nauk Armyanskoi SSR (1971). (In Russian).

The change occurring in the radiosensitivity of wheat seeds during the restoration of thermal injury was studied. As an index of the thermal injury, studies were mainly concerned with the change of penetrability of cells in relation to electrolytes. The penetrability of electrolytes increasing sharply just after the thermal effect is gradually restored. The data obtained show that the change of penetrability is followed by that of stability in relation to irradiation. These changes take place as mutually connected processes. They show the complex relation existing between the physiological-structural state and radiosensitivity of seeds. (auth)

20059 POST-IRRADIATION EFFECT OF HETEROAUXIN DEPENDING ON THE X-RAYS DOSES. Araratyan, L. A. pp 59-67 of Mutagenez rastenii. Vypusk 1. Gulkanyana, V. O. (ed.). Erevan; Izdatel'stvo Akademii Nauk Armyanskoi SSR (1971). (In Russian).

By applying the method of anaphasic analysis of chromosome aberration, the effect of post-irradiation application of heteroauxin was seen to be dependent on the different doses of irradiation. When seeds of Allium fistulosum were irradiated with doses of 2.5, 5, 7.5, 10 kR x rays and then wet with a solution of heteroauxin, a decrease in the percentage of cells containing injured chromosomes was noted only in the variant of the 10 kR x-ray dose. Protection level is 33.3%, coefficient of subsidence of dose is 1.3. It was also noted that the effect of heteroauxin is definitely dependent on the time elapsing between irradiation and the wetting of seeds. Delaying of wetting hinders the protective action of the protector. (auth)

20060 EFFECT OF POST-IRRADIATION OF INDOLACETIC ACID DEPENDING ON ITS DENSITY. Araratyan, L. A. pp 68-74 of Mutagenez rastenii. Vypusk 1. Gulkanyana, V. O. (ed.). Erevan; Izdatel'stvo Akademii Nauk Armyanskoi SSR (1971). (In Russian).

Seeds of Allium fistulosum L immediately after having been irradiated with a 10 kR dose of x rays were put in IAA indoleacetic acid solutions of different densities for 24 hrs, as a result of which the number of cells bearing chromosome mutations decreased. The percentage of the injured cells decreased with the increasing density of the IAA solution. None of the heteroauxin densities showed a protective effect after being irradiated with a 5 kR x ray dose. A certain effect of post-irradiation of heteroauxin could also be noted on the division of cells, sprouting of seeds, and the growth of small roots, but the results cannot be related to the regularities of the restoration of the injured chromosomes. (auth)

20061 EFFECT OF HIGH TEMPERATURE ON THE AMOUNT OF CHLOROPHYLL MUTATIONS OF BARLEY TREATED WITH X RAYS AND ETHYLENIMINE. Babayan, R. S.; Airapetyan, R. B.; Muradyan, A. A. pp 75-80 of Mutagenez rastenii. Vypusk 1. Gulkanyana, V. O. (ed.). Erevan; Izdatel'stvo Akademii Nauk Armyanskoi SSR (1971). (In Russian).

Thermal treatment of seeds under 80°C for 30 min was applied as an alternator of x rays and genetic effect of ethylenimine. It was noted that when seeds of barley undergo a thermal treatment before irradiation or wetting in a 0.03% solution of ethylenimine, their stability increases in the first generation with regard to those factors, while in the second generation, on the contrary, the amount of chlorophyll mutations increases twice as much. Thermal treatment assists in increasing the relative and absolute amount of chlorophyll mutations. This way of treating seeds might probably be used in mutation selection. (auth)

20062 EFFECT OF THERMAL TREATMENT ON THE CAUSE OF CHROMOSOME ABERRATIONS IN THE WHEAT BEFORE BEING SUBJECT TO X-IRRADIATION. Babayan, R. S.; Airapetyan, R. B.; Musaelyan, M. S. pp 81-87 of Mutagenez rastenii. Vypusk 1. Gulkanyana, V. O. (ed.). Erevan; Izdatel'stvo Akademii Nauk Armyanskoi SSR (1971). (In Russian).

This study is based on the fact that high temperature suppresses

metabolism in seeds, creating a specific kind of stable state, which causes them to acquire a high radiostability. Following the thermal treatment, the seeds, irradiated in different dates, were allowed to sprout and the number of chromosome aberrations in them was calculated. The number was dependent largely on the duration of irradiation. There seems to be a parallel process between the restoration of thermal injury and the increase of radiosensitivity. By irradiating the seeds in different dates following the thermal treatment, it should be possible to some extent to regulate the general and cytogenetic effect of irradiation. (auth)

20063 EFFECT OF X-RAYS ON POTATOES DEPENDING ON THE PHYSIOLOGICAL STATE OF TUBERS AND GROWING CONDITIONS OF PLANTS. Avakyan, V. A. pp 88-95 of Mutagenez rastenii. Vypusk 1. Gulkanyana, V. O. (ed.). Erevan; Izdatel'stvo Akademii Nauk Armyanskoi SSR (1971). (In Russian).

Experiments were carried out with tubers of the Lorkh species, which were irradiated before and after vernalization, as well as unvernalized just before planting. Tubers were irradiated with 100, 500, 1000, 2000, and 3000 R x-ray doses. It was found that irradiation with 500 to 1000 R x-ray doses before vernalization of tubers stimulates growth of the plants in spring, while in summer the effect is felt when tubers are irradiated with 100 to 1000 R x-ray doses. Irradiation of unvernalized tubers, just before planting them, has no stimulating effect. The 3000 R x-ray dose, independently of the physiological state of tubers under irradiation, responds well to the suppressive effect of x rays. (auth)

20064 EFFECT OF AET ON BARLEY SEEDS UNDER IRRADIATION. Panoyan, R. E. pp 96-105 of Mutagenez rastenii. Vypusk 1. Gulkanyana, V. O. (ed.). Erevan; Izdatel'stvo Akademii Nauk Armyanskoi SSR (1971). (In Russian).

Studies on the effect of S, β-aminoethylthiourea (AET) and x rays on the sprouts of barley have shown that before, after, and during irradiation, treatment of barley seeds with AET water solutions has an anti-irradiation effect. It was also seen that during the irradiation with a 20 to 25 kR x-ray dose, the suppression of growth was stronger in the small roots than in the sprouts. With a higher dose of x rays, the effect of AET solution on the small roots was stronger than on the sprouts. (auth)

Radiation Effects on Animals

Refer also to abstracts 19818, 19821, 20008, and 20159.

20065 METHODS FOR DETERMINATION AND COMPUTATION OF ABSORBED DOSE AND NEUTRON SPECTRUM WITHIN BIOLOGICAL OBJECTS. Broerse, J. J.; Broers-Challiss, J. E. (Radiobiological Inst. TNO, Rijswijk, Netherlands). pp 57-66 of Radiobiological Applications of Neutron Irradiation. Vienna; International Atomic Energy Agency (1972).

From Meeting on radiobiological applications of neutron irradiation; Vienna, Austria (6 Dec 1971). See STI/PUB-325; CONF-711204.

A complete specification of the energy dissipation by fast neutrons in biological material requires a statement of the absorbed dose and an assessment of the radiation quality that can be related to the neutron energy spectrum or the LET spectrum. A number of theoretical considerations and experimental techniques to determine these parameters within a biological object are reviewed and discussed. The possibility of a variation in the neutron spectrum is assessed with particular reference to changes of values of the relative biological effectiveness at depth in a phantom. (auth)

Man

20066 (AEC-tr-7401) RADIATION SICKNESS IN MAN. Translation of Luchevaya Bolezn' Cheloveka, 1971, Moscow, Izdatel'stvo Meditsina. Feb 1973. 560p. Dep. NTIS.

This cover-to-cover translation of the Russian-language book discusses the pathogenesis and therapy of radiation sickness in man in 13 chapters, divided into four sections. The first section is devoted to a classification of radiation responses at various dose levels and other etiological factors affecting the development of radiation sickness. The second section discusses acute radiation sickness and its prognosis and treatment. The third section discusses chronic radiation sickness in relation to local partial-body or whole-body external irradiation. The fourth section discusses clinical problems in diagnosis, prophylaxis, and treatment. (850 references) (CH)

20067 (INIS-mf-242) ANNUAL REPORT, 1970. (National Inst. of Radiation Protection, Stockholm (Sweden)). 1971. 130p. (In Swedish). INIS.

An account is given of the activities of the National Institute of Radiation Protection in Sweden in 1970. Included is statistical information in 27 tables with headings in English. (Sweden)

20068 (NP-19662) RADIOSENSITIVITY OF THE LUNG. Maisin, J. R. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). [nd]. 14p. Dep. NTIS (U.S. Sales Only).

Data on the pathological effects of both external and internal irradiation on the lungs of mammals are reviewed, and implications for planning radiotherapy of neoplasms of human lungs are considered. Data show that the parenchyma of the lung exposed to a supralethal dose of x irradiation (2000 R) is strongly affected. Three to four months after treatment, the alveoli are obstructed by fibrin and myelin debris and marked lesions of the capillaries and a thickening of the wall of the alveoli are present. Fractionation increases the tolerance of the pulmonary tissues to irradiation. Functional modifications are marked when more than 50% of the parenchyma of the lung is damaged. No active treatment of the lesions of lung parenchyma is yet known. It is concluded that radiotherapy of lung cancer in human has been a failure because the lung tissues have such a low tolerance to irradiation and because the neoplasm per se is very radioresistant. (CH)

20069 (ORNL-4811, pp 97-8) WEIGHT OF THE LUNGS PLUS FLUIDS FOR REFERENCE MAN. Snyder, W. S.; Hilyer, M. J. C.; Stoholski, A. P. Sep 1972.

In Health Physics Division annual progress report for period ending July 31, 1972.

One of the problems encountered in establishing reference man was determining the weights for the lungs, including a normal amount of blood. Because these difficulties in establishing weights of total lung, parenchyma, and lung blood, a special study was set up for obtaining these data from individuals whose age, sex, total body weight, total body height, and cause of death are known. Data are presented from twenty cases, sixteen males and four females. The weight of the lungs plus blood was somewhat better correlated with total body weight than with total body height or surface area. Less variation was found for the lungs plus blood as a percentage of the total body weight than for correlation with other parameters tested. (CH)

20070 (ORNL-4811, pp 108-14) DOSE ESTIMATION STUDIES RELATED TO PEACEFUL USES OF NUCLEAR EXPLOSIVES AND OTHER RADIONUCLIDE RELEASES. Barton, C. J.; Booth, R. S.; Kaye, S. V.; (and others). Sep 1972.

In Health Physics Division annual progress report for period ending July 31, 1972.

Mathematical simulations of selected environmental systems were developed, which can be used as modules in construction of environmental models to predict the fraction of each released radionuclide exposing man as a function of time at any given location. One end point of the radiological assessment is an index identified by the acronym CUEX, which stands for CUmulative Exposure IndeX. The numerical value of CUEX for a specific radionuclide release reflects the magnitude of the estimated total dose to individuals or populations relative to a selected dose limit. Application of the generalized model to quantitatively predict radionuclide movement through terrestrial food pathways is described. A prime area for application of CUEX is the assessment of radionuclide releases from nuclear power stations. Methods developed under this activity were used to complete radiological sections of environmental impact statements. Computer programs are also being developed for use in calculations of the radiation dose to human population due to exposure to combustion products of natural gas from a multi-well field stimulated with nuclear explosives. (CH)

20071 (STI/PUB-325) RADIOBIOLOGICAL APPLICATIONS OF NEUTRON IRRADIATION. Panel Proceedings Series. Proceedings of a Panel Held in Vienna, 6-10 December 1971. (International Atomic Energy Agency, Vienna (Austria)). Aug 1972. 270p. (In French and English). (CONF-711204). IAEA $9.00.

Separate abstracts were prepared for 19 papers presented at the conference. The remaining three papers were previously abstracted for NSA. For abstracts of these papers see CONF-711204 in the Report Number Index. (HLW)

For abstracts of individual papers see: 20011-20013, 20038-20043, 20065, 20081, 20082, 20126-20129, 20150, 21891, and 21892.

20072 (SZS-145) OCCUPATIONAL RADIATION EXPOSURE IN THE GDR IN 1970. Koenig, W.; Larssen, A.; Rothe, W. (Staatliche Zentrale Fuer Strahlenschutz, Berlin (East Germany)). Oct 1972. 24p. (In German). Dep. NTIS (U.S. Sales Only).

In 1970, 30,599 occupationally exposed persons were monitored by the central film badge service of the National Center for Radia-

tion Protection. The monthly over-exposures (more than 0.4 rad) totaled 573. In 28 cases the quarterly dose (3 rad) was exceeded during one month. Twenty-six of these records could be assessed as real over-exposures. Most of the over-exposures could be attributed to an insufficient application of safety regulations. The results were analyzed according to type of institution, type and duration of employment, as well as age of employees. (auth)

20073 (TID-26282) QUANTITATIVE ANALYSIS OF INTESTINAL CRYPT SURVIVAL FOLLOWING X-IRRADIATION. Progress report, 1971-1972. Hagemann, R. F. (Allegheny General Hospital, Pittsburgh, Pa. (USA). Cell and Radiation Biology Labs). 1972. Contract AT(11-1)-3098. 5p. Dep. NTIS.

Progress is reported on the following studies: effects of partial body x radiation on the intestinal epithelium and the role of the myelopoietic system; crypt cell proliferation kinetics following high exposures of radiation; repair of radiation damage in G_1 and S phases; delayed effects of intestinal irradiation; differentiation and DNA synthesis in crypt cells of human intestine; and sensitizing effects of actinomycin D on the x-irradiated intestine. (HLW)

20074 (UCID-15506) CRITICISM OF THE STERNGLASS ARTICLE ON FETAL AND INFANT MORTALITY. Tamplin, A. R.; Ricker, Y.; Longmate, M. F. (California Univ., Livermore. Lawrence Radiation Lab). 22 Jul 1969. 37p. Dep. NTIS.

A critical review is presented of published data on the effects of fallout radiation on infant and fetal mortality in the USA. Data from the Vital Statistics Tables for 1920 through 1970 are reviewed with emphasis on the number of fetal deaths in relation to live births in California and New York. No relationship was found between fallout radiation and infant and fetal mortality. It is concluded that the major factors that have influenced infant and fetal mortality during the past 50 years are social-economic conditions and the introduction of antibodies. (CH)

20075 NEW CANCERS ARISING IN 1,563 PATIENTS WITH CARCINOMA OF THE CERVIX TREATED BY IRRADIATION. Morton, R. F.; Villasanta, U. (Univ. of Maryland, College Park). Amer. J. Obstet. Gynecol.; 115: No. 4, 462-466(15 Feb 1973).

Incidence of multiple primary cancers developing in 1,563 patients treated for invasive carcinoma of the cervix is considered. They were all treated by radium and/or external irradiation. Follow-up was complete with the exception of 69 patients (4.4%). Total person years of observation was 8,323. Thirty second primaries of different organs and of different cell type were found. Skin cancers and multicentric squamous-celled cancers were excluded as were synchronous cancers. The observed number of second primary cancers (30) was compared to the expected number (29.2) derived from the Connecticut Cancer Registry, with the use of age- and site-specific incidence rates. No increased incidence of second cancer was found among the patients studied. (auth)

20076 OCCUPATIONAL X-RAY EXPOSURE. ASSOCIATED WITH INCREASED UPTAKE OF RUBIDIUM BY RED CELLS. Scott, K. G.; Stewart, E. T.; Porter, C. D.; Sirafinejad, E. (Univ. of California, San Francisco). Arch. Environ. Health; 26: No. 2, 64-66(Feb 1973).

A change in rubidium chloride ^{86}Rb red blood cell kinetics may reflect the effect of low levels of radiation on bone marrow. In radiology workers who received x ray exposures considered to be of acceptable levels, the uptake of ^{86}Rb by the erythrocytes was greater than in those receiving no measurable occupational exposure. Uptake was greatest at multiples of two to three times natural background and was greater in those persons with fewer than ten years of occupational exposure. (auth)

20077 BURNS OF THE DORSUM OF THE HAND. Barsky, A. J. Hand; 3: No. 1, 88-89(Mar 1971).

A description is presented of the changes in the dorsal skin of the hand following radiation burns. Changes include delayed cell division, transient erythema, edema, desquamation, ulceration, and changes in the color and texture of the nails. Treatment of thermal burns and preparation of the skin for grafting are discussed. Late effects include infection and pain due to inelasticity of scar tissue. Various techniques of skin grafting are described. (HLW)

20078 HEPATITIS ASSOCIATED ANTIGEN AND ANTIBODY IN A-BOMB SURVIVORS AND NONEXPOSED SUBJECTS IN HIROSHIMA AND NAGASAKI. Belsky, J. L.; Okochi, K.; Ishimaru, T.; Hamilton, H. B. (Atomic Bomb Casualty Commission, Hiroshima). Radiat. Res.; 52: No. 3, 528-535(Dec 1972).

Using a method of immune adherence hemagglutination, hepatitis associated antigen was found in 4.09% of males and 2.10% of females in Hiroshima and Nagasaki, Japan. The prevalence of positive antigen tests among those heavily exposed to atomic radiation was higher, but not significantly different from those exposed to low doses. Anti-HAA antibody was present in about 10% of males and 12% of females, and the lowest rates were present in persons over 60 years. The prevalence of antibody was similar in heavily and lightly exposed A-bomb survivors. These results were considered to represent limited evidence against altered host-antigen or antibody forming mechanisms as delayed effects of atomic radiation. (auth)

20079 DEVELOPMENTS IN SPACE MEDICINE. Warren, S. Astronaut. Aeronaut.; 11: No. 1, 18-22(Jan 1973).

Topics covered include: early predictions and Skylab questions; atmospheres, aptitudes, and cautions; handling quarantine, exobiology, shuttle payloads philosophy, radiation hazards and risks; and medical benefits. (14 references) (MCG)

20080 OCCUPATIONAL EXPOSURE TO X RAYS IN THE YEARS 1966-1970. Jankowski, J.; Krych, B. Pol. Przegl. Radiol. Med. Nukl.; 36: No. 5, 637-643(1972). (In Polish).

The results of measurements of the individual doses received by persons with occupational exposure to x rays in Poland are reported. The measurements were performed using dosimetric films in 14,760 persons. The results of this study carried out in the years 1966 to 1970 show a systematic rise in the number of persons with exposure not exceeding 400 mR annually, i.e., $1/12$ of the admissible annual dose. In 1970 the group accounted for 98.3% of all studied subjects. A systematic decrease was found also in the number of persons in whom the three-month or yearly doses had been exceeded. In 1970, 30 cases were recorded in which the admissible three-month dose had been exceeded, and 9 cases with admissible yearly doses exceeded. In all these cases, with one exception, the admissible three-month or annual dose had been exceeded within one month. On the basis of these results, it was concluded that the conditions of labor hygiene with regard to protection against ionizing radiation in radiological laboratories are good and only accidental breaching of the rules of work hygiene occurs. (auth)

20081 NEUTRON SOURCES FOR RADIOBIOLOGY: AN INTRODUCTORY REVIEW. Whetstone, S. L. (International Atomic Energy Agency, Vienna). pp 1-7 of Radiobiological Applications of Neutron Irradiation. Vienna; International Atomic Energy Agency (1972).

From Meeting on radiobiological applications of neutron irradiation; Vienna, Austria (6 Dec 1971). See STI/PUB-325; CONF-711204.

A brief review is presented of practical neutron irradiation sources (including some of the basics of neutron production) intended to set the stage for the subsequent specialized, detailed papers. The neutron sources described include: nuclear reactors, radioactive isotopic sources, neutron generators, and other sources involving accelerators. Although the usefulness of research reactors is acknowledged, greater emphasis is given to the role of D-T neutron generators, particularly those of the commercially available sealed-tube type, since it is considered that these are the most appropriate sources for the smaller, budget-limited radiobiology groups needing on-site neutron-irradiation facilities. Some news is given of efforts in the USA to develop high-output D-T neutron generators for therapeutic applications. Also cited is the potentially extremely useful, and in many ways unique, spontaneously-fissioning ^{252}Cf isotopic neutron source, which, although still too costly for many applications, is already available for world-wide use. (auth)

20082 APPLICATIONS OF FAST NEUTRON BEAMS IN RADIATION THERAPY. Fowler, J. F. (Mount Vernon Hospital Middlesex, Eng.); Bewley, D. K. pp 239-51 of Radiobiological Applications of Neutron Irradiation. Vienna; International Atomic Energy Agency (1972).

From Meeting on radiobiological applications of neutron irradiation; Vienna, Austria (6 Dec 1971). See STI/PUB-325; CONF-711204.

Use of fast neutron beams for radiotherapy is reviewed. Neutron capture therapy with boron drugs and thermal neutrons is not feasible because of the poor physical penetration, and the use of epithermal neutrons is not at present being developed further. Fission-spectrum neutrons, or other fast neutrons with mean energies of less than about 7 MeV, do not provide sufficient physical penetration to be useful. The properties of fast neutron beams from small and medium-sized cyclotrons and from D-T generators (14-MeV monoenergetic) are discussed. The potential advantage of the fast neutron beams is that the radiation-resistant effect of hypoxic cells in malignant tumours is smaller with neutrons than with x rays. Therefore more damage can be done to hypoxic tumour cells by neutrons than by x rays for a given degree of injury to well-oxygenated normal tissues. A clinical trial is in progress at Hammersmith Hospital using the MRC cyclotron beam. During 1971 it has developed into a randomized controlled

trial. In the two years up to 30 November 1971, 170 patients have been treated with fast neutrons. Long-term results are not available but the early results are at least as encouraging as those of x rays or ^{60}Co. (auth)

20083 OBSERVATIONS ON RADIATION RESPONSE OF TUMOR AND HEALTHY TISSUE IN CANCER PATIENTS GIVEN A DYNAMIC DOSE-FRACTIONATION UNDER OXYGEN BREATHING. Siracka, E.; Durkovsky, J.; Jancina, J.; Revesz, L. (Cancer Research Inst., Bratislava). Strahlentherapie; 144: No. 5, 584-590 (Nov 1972)

Results of a dynamic dose-fractionation regime combined with breathing of atmospheric oxygen in patients with head and neck, uterine cervix, and urinary bladder cancer are reported. The treatment consists in application of 2 to 3 large doses given in 2 to 3 consecutive days while the patient is breathing oxygen, and subsequent daily application of 2 × 100 rad 6 to 8 hr apart without oxygen up to 3000 rad. After a radiation-free interval of 1 week, the same scheme is applied again until 6000 to 7000 rad are reached. The regime was developed from experimental observations that indicate radiation dose dependence of the net oxygen effect on cellular survival. The clinical trial is in progress to allow the evaluation of long term results regarding both the cancer control and the late changes of the healthy tissue. (auth)

20084 CHANGES IN THE BLOOD PICTURE IN THE COURSE OF POSTOPERATIVE IRRADIATION OF THE LYMPH FLOW IN PATIENTS WITH SEMINOMA. Renner, H.; Hassenstein, E. (Univ., Basel). Strahlentherapie; 144: No. 5, 595-601(Nov 1972). (In German).

In 31 patients with seminoma, the quantitative changes of the peripheral leukocyte count under the influence of a largely uniform postoperative prophylactic irradiation of retroperitoneal lymph flow with 4000 R, measured on the focus, were examined. Thereby, the total leukocyte count shows a moderate but significant decrease ($p < 0.001$, t-test). At the end of irradiation the lymphocytes and lobocytes are significantly reduced ($p < 0.001$, t-test). The karyocytes were decreased in 17 patients; increased in eight patients. The eosinophil leukocytes were increased in 10 patients; decreased in 15 patients. The monocytes under radiotherapy did not show much change. The tested changes in the blood picture were independent from the radiation quality applied. The personal observations are discussed in relation to the reports in literature. (auth)

20085 RADIATION PNEUMONITIS, FIBROSIS, AND IMPAIRMENT OF THE PULMONARY BLOOD FLOW FOLLOWING POSTOPERATIVE IRRADIATION OF THE OPERATION AREA WITH ^{60}Co-GAMMA RAYS IN PATIENTS WITH CARCINOMA OF THE BREAST. Zwicker, H.; Felix, R.; Assheuer, J.; Sobbe, A. (Univ., Bonn). Strahlentherapie; 144: No. 5, 573-583(Nov 1972). (In German).

An evaluation of the literature indicates the favorable effect of postoperative Co-irradiation of the thoracic wall in cases of carcinoma of the breast stage B and C, in spite of contrary opinions. Fifty women with carcinoma of the breast (Steinthal I and II) were treated postoperatively with ^{60}Co gamma rays. The therapy was performed according to the so-called Birkner technique, over four stationary fields, including the thoracic wall by two tangential fields. In 6% (n = 50) the radiological checkup 3 to 12 months after the end of irradiation showed a transitory circumscribed pneumonitis in the peripheric caudal and ventral part of the inferior lobe below the irradiated thoracic wall; no fibrosis was observed (n = 50). The computer scintigraphy of the lungs, with determination of the relation of activity distribution, before and 6 up to 11 months after irradiation ended, resulted in a slight decrease of pulmonary blood flow (3%) in the irradiated side only in 2 out of 10 patients. If irradiation with 6000 R covers sternal, supraclavicular, infraclavicular, and axillar lymph nodes on the affected side as well as the thoracic wall in the operation area, the radiation exposure of the spinal marrow and the lung, according to measurements on the Alderson phantom, does not exceed 2000 R. Only in the peripheric caudal and ventral part of the inferior lobe below the irradiated thoracic wall the values of radiation exposure are higher; therefore, the 3 observed cases of pneumonitis were localized in that region. (auth)

20086 RADIATION PROTECTION MEASURES TO DECREASE THE UNNECESSARY RADIATION BURDEN. Dosay, Karoly. Magy. Radiol.; 24: No. 5, 284-287(Oct 1972). (In Hungarian).

Representatives of several health and radiological organizations met in 1964 to check the effectiveness of radiation protection devices recommended for use in radiological practice to reduce the radiation burden of the population. Recommendations resulting from this discussion and similar proposals issued later are reviewed. Use of 0.3 mm Pb-equivalent lead-containing rubber is recommended for use in the form of protective gloves, sheets, blankets, and aprons, because experiments revealed that at voltages employed in diagnostic radiography, the attenuation of the radiation is nearly 95%. Personnel performing radiologic work at the bedside with portable equipment should be protected by using a 4 to 5 m extension cord for triggering the exposure; a portable lead or lead-containing rubber screen should be used to protect the patient. Special attention is turned to the protection of the gonads by means of a tubular shield, recommended for hip exposures. Portable lead shields are very useful to reduce the volume dose. Fluoroscopic instruments should be provided with a visible or audible warning system. Other devices, such as polaroid spectacles for eye protection, special shields for children and infants, protective systems used in bronchographic, angiographic, and heart catheterization practice are briefly mentioned. (TTT)

20087 EVALUATION OF THE HEALTH RISKS DUE TO MEDICAL RADIATION BURDEN OF THE POPULATION. Predmerszky, Tibor. Magy. Radiol.; 24: No. 5, 290-292(Oct 1972). (In Hungarian).

The value of radiolographic and isotopic diagnostic information as compared against the risk to the population because of the effects of the radiation exposure is discussed. The risk is indicated by the higher mortality reported for American radiologists as compared with general medical practitioners and specialists. (TTT)

20088 PROPOSALS CONCERNING THE REDUCTION OF THE RADIATION BURDEN OF THE POPULATION. Varteresz, Vilmos. Magy. Radiol.; 24: No. 5, 293-295(Oct 1972). (In Hungarian).

The widespread use of various radiation sources has resulted in an increase of the exposure of the population at large. Studies revealed that most of the irradiation is due to medical diagnostic applications. An intensive cooperative effort was initiated to reduce the exposure to the lowest possible level by: improving the technical devices used for radiography; providing protective shields; improving the methods used for all diagnostic examinations using radiation sources or radioisotopes; supervising and examining closely the advisability of all radiological tests; introducing strict administrative procedures, such as personal records of all exposures of the individual to radiation; and postgraduate training of radiologists and other medical personnel in radiation protection methods. In addition, 26 specific measures are proposed for adoption. (TTT)

20089 NEW METHOD FOR IRRADIATION OF THE BILATERAL CERVICAL LYMPHATIC SYSTEM WITH ^{60}Co γ RAYS. Kuhn, E.; Gyuedi, S. (Medizinische Univ., Pecs, Hungary). Strahlentherapie; 144: No. 4, 398-406(Oct 1972). (In German).

A report is given about an irradiation method by which the whole bilateral cervical lymphatic system can be reached. The telecobalt irradiation is performed via a ventral and a dorsal field of 15 × 15 cm size, with a source-skin-distance of 60 cm. The varying layer thickness of the throat is compensated by two harmonic plumbum wedge-filters; a central plumbum bridge serves to save the larynx and the cervical marrow. Using a focal dose of 6000 rd, the irradiation exposure of the larynx and the cervical marrow amounts to about 2000 to 2500 rd. Results of extended measurements on the model as well as indications and early results of the irradiations are reported. (auth)

20090 CHROMOSOMIC EXAMINATIONS ON PATIENTS IN THE REPRODUCTIVE AGE EXPOSED TO REPEATED RADIOLOGICAL TESTS OF THE STOMACH. Hajdu, Imre; Balogh, Istvan; Forgacs, Sandor; Czeizel, Endre. Magy. Radiol.: 24: No. 5, 310-313(Oct 1972). (In Hungarian).

Fifty patients, including 27 men and 23 women, aged from 23 to 41 years exposed to more than 3 gastric radiographic diagnostic examinations, but not to radiation therapy, were the subjects of chromosomic examinations, following the technique described by P. S. Moorhead et al., in order to determine the number of chromosome aberrations. The peripheral blood samples from 36 persons yielded usable data. In 14 patients, or 38.8% of the cases, it was possible to detect the presence of dicentric chromosomes, considered the most sensitive indication of radiation injury, in cultured lymphocytes. The high level of injury indicates that radiographic examinations of the stomach should be severely restricted and used only when absolutely necessary. This biological dosimetry technique shows promise as an ideal dosimetric tool because it is able to detect low levels of irradiation; dicentric chromosomes were detected after exposures to 2.5 to 5 R. The chromosomal aberrations may be detected even several years after the radiation exposure. (TTT)

20091 DOSE MEASUREMENTS DURING DIAGNOSTIC X-RAY EXAMINATIONS TO DETERMINE THE RADIATION EXPOSURE OF THE POPULATION. Luzsa, Gyoergy (Municipal Hospital, Mosonmagyarovar, Hungary). Magy. Radiol.; 24: No. 5, 277-280 (Oct 1972). (In Hungarian).

In order to determine the radiation burden due to routine radiographic examinations, exact dosimetric measurements were carried out, using Forte type films with diagnomax M125 type x-ray machine. The chest exposures of 1200 patients were studied, using one film for 500 patients; in case of stomach studies, 25 exposures were made on each film. The exposed films were evaluated by a densitometer and the blackening determined in 1125 points in each film. In the case of chest exposures, each male patient was exposed to a surface dose of 543.7 R cm^2; female patients were exposed to 412.8 R cm^2. The difference is attributed to differences in the size of the chest. In case of stomach exposures, the values were 1656.5 R cm^2 for men and 756.5 R cm^2 for women. The differences encountered between positive and negative cases and between children and adults were also evaluated. Work is in progress on the evaluation of the effectiveness of radiation protection measures. (TTT)

20092 DOSIMETRIC PHANTOMS. Nikl, Istvan. Magy. Radiol.; 24: No. 5, 288-289(Oct 1972). (In Hungarian).

The reasons for the use of phantoms in dosimetric research are reviewed. It is impossible and also unnecessary to mock up all the parameters of human tissue because no solid contains C, H, O, and N in the same ratio as soft tissue. Although some of the above four elements may be missing, many of the energy transfer processes occur in the same manner as in the tissue itself. When modeling bones by using a mixture based on the composition of the bone, it must be kept in mind that bones of living mammals are hollow. The bulk density of the bone varies from 1.6 to 1.9 g/cm^3; this is an important factor because of the importance of the bone marrow dose. The materials used for the construction of phantoms are characterized primarily by their electron density, effective order number, absorption coefficient, shape of the energy spectrum and spatial distribution of the absorbed dose. Correction factors must be posed to take into account the heterogeneous nature of the body caused by the presence of the air-containing gastrointestinal tract. In case of a 4 MeV x irradiation, a 5 to 8 cm lung tissue layer increases the nominal depth dose by 15%; in case of irradiation by means of a ^{60}Co γ source the increase is 20% and in case of a 300 kV therapeutic irradiation, it is 40%. It is recommended to standardize the phantom systems used in dosimetry. (TTT)

20093 ROLE OF FILM DOSIMETRY IN THE DETERMINATION OF THE RADIATION BURDEN OF WORKERS PROFESSIONALLY EXPOSED TO RADIATION. Wachsmann, Felix. Magy. Radiol.; 24: No. 5, 296-300(Oct 1972). (In Hungarian).

The many advantages presented by film dosimeters for radiation monitoring of medical personnel (e.g., determination of the type, energy, direction of the radiation, identification of deliberate exposures, contaminations, partially covered foci, special effects, such as heating or chemical vapors, differentiation between single and repeated exposures) are reviewed. Film-based systems may be processed economically at a distance from the location used by use of a mail service. Certain new techniques, used to determine the radiation dose of dentists during radiographic examinations of teeth, the skin dose of radiologists during fluoroscopy, the gonad dose, etc., are briefly mentioned. The sensitivity of radiological films and foils may be determined by irradiating the film-foil combination together with a thermoluminescent dosimeter to 3 different exposures, corresponding to lung, stomach, and hip irradiation using a suitable phantom and comparing the darkening of the film with that obtained under standard conditions. The dark room work must be closely controlled. All these methods are useful to reduce the irradiation of physicians and their patients. (TTT)

20094 DATA ON THE RADIATION PROTECTION POSITION OF THE MEDICO-RADIOLOGICAL WORK AREAS OF THE SEMMELWEIS UNIVERSITY OF MEDICAL SCIENCES. Boros, Laszlo; Szy, Denes; Toeroek, Istvan. (Semmelweis Univ. of Medical Sciences, Budapest). Magy. Radiol.; 24: No. 5, 301-309(Oct 1972). (In Hungarian).

The health physics group of the University is responsible for measures aimed at the radiation protection of about 420 staff members at various clinics and medical institutes in Hungary who may be exposed to ionizing radiation. Film dosimetric measurements revealed that the annual average whole-body exposure was considerably below the permissible 4 rem level. The 3-year average of 95% of the persons checked stayed below 10% of the maximum permissible exposure. Researchers in the isotope laboratory exhibited the lowest external exposure; the worst situation was experienced in the gynecological radiology clinic. A Va-J-15 A type Vakutronic x-γ radiation dosimeter was used for local monitoring; the instrument was calibrated with a tissue equivalent water phantom. The unsealed and sealed radiation sources, the latter consisting mostly of ^{226}Ra γ sources for implant therapy, and ^{60}Co γ sources used for human therapy, were checked by means of film and solid-state dosimeters. The presence of α and β emitting contamination was determined by an FHT 111 type Frieske-Hoepfner device; a RUP type Soviet instrument was used for the detection of α emitters. The findings of the various departments and institutes are presented in tabular form. (TTT)

20095 RADIATION PROTECTION PROBLEMS OF ELECTRONIC X-RAY IMAGE FORMATION. Toeroek, Istvan. Magy. Radiol.; 24: No. 5, 280-283(Oct 1972). (In Hungarian).

It has been claimed that electronic image amplification of x-ray pictures result in a considerable reduction of the exposure of medical personnel. This claim was found to be unfounded when the body diameter of the patient was large because of the increasing number of radiation quanta reduces the signal/noise ratio. Experiments were carried out to evaluate the radiation risks involved in the use of TV-type amplifying screens, using $CaSO_4$: Mn thermoluminescent finger dosimeters. The better way was to evaluate the annual radiation burden of radiologists involved in clinical diagnostic work on the basis of their work load. It was found that the radiation dose to the hands did not exceed 22 mR; the gonad dose ranged from 300 to 350 mR. Similar studies were also made on the radiation exposure of teams involved in selective angiographic examinations. The results revealed that the use of this type of device is not without danger. (TTT)

20096 EFFECT OF OXYPHENBUTAZON ON RADIATION PNEUMONITIS AND RADIATION FIBROSIS AFTER IRRADIATION OF BREAST CANCER. Klein, U.; Mueller-Fassbender, H.; Bublath, H.; Heinze, H. G. (Univ., Munich). Strahlentherapie; 144: No. 4, 421-429(Oct 1972). (In German).

In 116 patients with carcinoma of the breast, postoperatively irradiated using telecobalt 60 under equal conditions, the effect of oxyphenbutazon was tested by a double placebo experiment. Radiological symptoms of radiation pneumonitis were not fully developed before the 6th month of irradiation; they were found in 89% of the placebo-group and in 72% of the group treated with oxyphenbutazon. The alterations were reversible; after 18 months radiation fibrosis was found in 55 and 36%, respectively. By prophylactic administration of oxyphenbutazon the frequency as well as the degree of severity in radiation-induced pulmonary alterations was reduced. (auth)

20097 DOSE DELIVERY AROUND LOCAL THERAPEUTIC RADIATION FIELD. Garsou, J. (Univ., Liege). J. Belge Radiol.; 55: No. 5, 539-546(1972).

Dose distributions were measured by MBLE CaF_2 thermoluminescent dosimeters in a rice phantom whose surface was normal to the axis of the beams used: 200 kV x rays, filtered by 0.2 mm Sn and 0.25 mm Al; Cs^{137} and ^{60}Co gamma rays; 34 MeV electrons; and 34 MV x rays. The size of the irradiated volume, materialized by the shape of the isodose curves, influences the trend of dose distributions on the three different levels considered in the phantom. The mean doses, expressed as fractions of the maximum dose in the axis of the beam, were calculated for the part of the phantom volume located outside a cylinder of 15 cm radius centered on the beam axis. The doses to the gonads at an approximate distance of 30 cm (ovaries) and 40 cm (testes) from the beam axis were estimated to be roughly of the order of 0.1 to 0.8% of the maximum dose in the beam for the different considered cases: the lowest doses were given by 200 kV x rays, 34 Mv x rays, and 34 MeV electrons beam. (auth)

20098 DEYSTVIYE MALYKH DOZ IONIZIRUYUSHCHEY RADIATSII NA TSENTRAL'NUYU NERVNUYU SISTEMU. (Effect of Small Doses of Ionizing Radiation on the Central Nervous System). Cherkasova, L. S.; Pikulev, A. T. (eds.). Minsk; Belorussian State University (1971). 112p.

The reports given at the All-Union Symposium on the effect of ionizing radiation on the central nervous system are discussed. Some of the papers were devoted to various problems of clinical radiation pathology, and others pertained to the metabolism of the brain and the role of the hypothalamus-hypophysis-adrenal system in radiation pathology. In two of the papers, an attempt was made to standardize the experimental procedure, assuming utilization of ionizing radiation. The results of some of the papers are of interest to researchers dealing with the problems of space radiobiology. (MCG)

20099 APPLICATION OF NUCLEAR CALCULATION METHODS TO THE PLANNING OF RADIATION TREATMENT WITH GAMMA RAYS. Hehn, G. (Univ., Stuttgart). pp 10-18 of Frontiers of Nuclear Medicine. Horst, W. (ed.). New York; Springer-Verlag (1971). (In German).

Computer programs were developed in recent years for design of nuclear reactions with improved shielding; these can be applied in radiology to provide a theoretical basis for earlier experimen-

tal work and semi-empirical methods. The Stuttgart PLK program, originally developed to determine heat sources and equivalent doses of mixed neutron and gamma radiation, was adapted to enable calculation by computer of the production of secondary electrons by gamma radiation in the tissues. Where penetration of secondary electrons can be neglected (x radiation and ^{60}Co γ radiation), the desired local distribution of the energy dose is found directly; where it cannot (betatron gamma radiation), the necessary information about the source of secondary electrons is obtained. Three examples are given to illustrate the efficiency of the method: a layer of homogeneous tissue, thigh, and head irradiation. Hard and soft x rays, cobalt gamma rays, and betatron bremsstrahlung were programmed at energy maxima of 10, 30, and 50 MeV. (auth)

20100 HYPOPITUITARISM AFTER EXTRACRANIAL IRRADIATION. Evidence for Hypothalamic Origin. Larkins, R. G.; Martin, F. I. R. (Royal Melbourne Hospital, Parkville, Australia). Brit. Med. J.; 1: No. 5846, 152-153(20 Jan 1973).

Brief case histories are presented showing hypothalamus involvement in hypopituitarism resulting from radiotherapy. The first case was a man aged 45, with a carcinoma of the nasopharynx, who had received a 3000 R dose of x-ray therapy given over 25 days. Hypopituitarism developed 6 years later, and macroscopic appearances at necropsy 16 years after irradiation showed involvement of the pituitary unlikely. The second case was a man aged 39 with carcinoma of the left maxillary sinus. He received 6,500 R in 20 increments over 32 days. Seven years later hypopituitarism was exhibited. At operation no evidence was found for tumor recurrence. Evidence for a hypothalamic site of the lesion was provided by a thyroid-stimulating hormone response to thyrotrophin releasing hormone, which was normal but delayed, typical of the pattern seen in hypothalamic disease and in contrast to the lack of response in patients with local pituitary destruction. (UK)

Vertebrates

Refer also to abstracts 20012, 20030, 20045, 20071, and 20081.

20101 (BNWL-SA-4484) DETECTION OF VIRUS-LIKE PARTICLES FROM RADIATION-INDUCED LEUKEMIA IN SWINE. Frazier, M. E. (Battelle Pacific Northwest Labs., Richland, Wash.). Dec 1972. Contract AT(45-1)-1830. 208p. Dep. NTIS.

Thesis. Submitted to Univ. of Montana, Missoula.

Virus-like particles were found in 15 of 19 miniature swine with radioinduced myelogenous or lymphocytic leukemia. The particles were not observed in preparations from 12 control animals. Cytopathogenic adenoviruses were isolated from both normal and leukemic swine. Long-term cell cultures from normal and leukemic swine displayed characteristics of transformed cells. The transformation always occurred if type C viruses were present. However, some cell cultures were apparently able to transform spontaneously in the absence of the type C particles. A type C virus was isolated from ten animals with myeloproliferative or lymphoproliferative disorders. These porcine viral isolates have properties similar to those of known oncogenic RNA viruses. Porcine embryonic kidney cells infected with the porcine type C virus become transformed in vitro indicating that these agents have an oncogenic potential. Based on findings reported here, the porcine type C virus is now considered as a candidate for classification as an oncornavirus. (HLW)

20102 SWELLING OF RAT LIVER MITOCHONDRIA IN THE PRESENCE OF THE RADIOSENSITIZING DRUGS 2-IODOACETAMIDE AND N ETHYLMALEIMIDE. Dinescu, G.; Mihai, C. Rev. Roum. Biochim.; 9: No. 1, 35-42(1972).

The effect of the radiosensitizing drugs 2-iodoacetamide (IAA) and N-ethylmaleimide (NEM) on the swelling of rat liver mitochondria was determined in vitro; the following types of swelling were investigated: pseudoenergized swelling in KCl, potassium acetate (KAc) and ammonium phosphate and energized swelling in KAc, KAc-ATP, KAc-succinate, sucrose-KAc-succinate. The influence of cysteine on the energized swelling in KCl–succinate was also followed. The results suggest that IAA and especially NEM induce an alteration of the outer mitochondrial membrane, expressed by an increase of the pseudoenergized swelling in KCl and KAc. The energized swelling, conditioned by the state of the inner membrane is influenced to a lesser degree by these drugs. NEM is a more potent swelling agent than IAA. (auth)

20103 DECREASED RISK OF EMBRYO MORTALITY FOLLOWING LOW DOSES OF RADIATION TO TROUT SPERM. McGregor, J. F.; Newcombe, H. B. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Radiat. Res.; 52: No. 3, 536-544(Dec 1972).

Decreased mortality was observed among embryos of rainbow trout as a result of exposure of the sperm to 25 and 50 rad of gamma rays, whereas higher doses of 200 and 400 rad result in increased mortality. The "beneficial" effect of the lower doses is more apparent during the early and intermediate stages of embryo development and the harmful effect of the higher doses is expressed mainly during the intermediate and later stages. Both effects appear to be due to hereditary changes since they each persist over many cell generations. The findings are of theoretical interest in relation to the shape of the lower end of the dose-effect curve for genetic changes, and of practical importance bearing on estimates of radiation-induced prenatal mortality in man. (auth)

20104 EFFECTS OF $^{144}Ce-^{144}Pr$ ON THE METAPHASE CHROMOSOMES OF THE CHINESE HAMSTER LIVER CELLS IN VIVO. Brooks, A. L.; McClellan, R. O.; Benjamin, S. A. (Fission Product Inhalation Labs., Albuquerque, NM). Radiat. Res.; 52: No. 3, 481-498(Dec 1972).

Chinese hamsters, of mixed sexes and 90 to 110 days old, were injected intraperitoneally with 0.45, 0.15, 0.05, 0.017, 0.006, 0.002, and 0.0 μCi of $^{144}Ce-^{144}Pr$/g body wt and partially hepatectomized at 4, 13, 40, 120, 360, or 720 days postinjection. The animals were injected with colchicine at 50 hr postsurgery, and sacrificed 4 hr later to measure the aberration frequency in the metaphase chromosomes. The dose to the liver was calculated using retention data combined with data on the activity of $^{144}Ce-^{144}Pr$ in the liver at the time of hepatectomy and sacrifice. The frequency of chromosome aberrations increased linearly through 362 days with an aberration coefficient of 3.1×10^{-4} aberrations/cell/rad. For doses up to 14,500 rads through 362 days of the study, there were no signs of saturation or plateauing of the radiation dose effect curve. At 722 days postinjection, the slope of the dose-response curve had decreased to 1.8×10^{-4} aberrations/cell/rad and the aberration frequency in the controls had more than tripled. Changing dose rate over a range of 2 to 250 rads/day had no effect on the frequency of aberrations/cell/rad. The efficiency of producing aberrations per rad of dose was equal to that observed after protracted ^{60}Co exposure. Over the first 362 days, the dose required to produce a level of chromosome damage that was two standard deviations higher than observed in the controls was 130 rad. There were three hepatocellular neoplasms and one bile duct adenoma observed in animals injected with the three highest levels of activity. (auth)

20105 DIFFERENCES IN THE GROWTH AND DIFFERENTIATION OF THE CFU FRACTION SURVIVING SUBLETHAL IRRADIATION. Gidali, J.; Feher, I.; Varteresz, V. (National Research Inst. for Radiobiology and Radiohygiene, Budapest). Radiat. Res.; 52: No. 3, 499-508(Dec 1972).

The following characteristic changes of self-reproduction, growth, and differentiation of CFU surviving 300 R ^{60}Co irradiation in vivo were found: (1) CFU duplication from IBM started 24 hr earlier than from CBM; (2) colonies from ICFU showed a more rapid growth at the beginning than colonies from control CFU; and (3) the ratio of erythroid : granuloid (E : G) colonies decreased and more megakaryocytic colonies were found in the IBM-transplanted group. The change in the E : G ratio proved to be transient. The more rapid growth of colonies and the earlier start of CFU duplication may be explained by the heterogeneity of the pluripotential CFU population. The possible selection of a more radioresistant CFU fraction is suggested. (auth)

20106 LIFESPARING ABILITY (IN LETHALLY IRRADIATED MICE) OF W/W^v MOUSE MARROW WITH NO MACROSCOPIC COLONIES. Harrison, D. E. (Jackson Lab., Bar Harbor, ME). Radiat. Res.; 52: No. 3, 553-563(Dec 1972).

Marrow suspensions from W/W^v genetically anemic mice had 13% the 30-day lifesparing ability of +/+ marrow cells in lethally irradiated recipients, but formed less than 0.01% as many macroscopic spleen colonies. Although 75×10^6 W/W^v cells produced no colonies after 9 or 10 days, they increased spleen weights significantly in irradiated recipients, but with less than 1% of +/+ cell efficiency. Nonerythroid cell proliferation (DNA synthesis) measured by $^{125}IUdR$ uptake in recipients of W/W^v cells was 44% that in recipients of +/+ cells. Erythroid proliferation was insignificant in recipients of W/W^v cells, and substantial (150% of nonerythroid proliferation) in recipients of +/+ cells. Recipients of large doses of W/W^v cells survived as well as +/+ cell recipients for 190 days, but more died between 190 and 372 days. The macrocytic anemia of the W/W^v cell donors was permanently acquired in 2 to 3 months by 60 to 80% of W/W^v cell recipients, and recipients saved by W^v/W^v marrow cells produced erythrocytes with donor-type hemoglobin. These results indicate that marrow cells can be effective at saving and repopulating lethally irradiated mice even though they form no macroscopic spleen colonies. (auth)

20107 EARLY FUNCTIONAL HEMODYNAMIC IMPAIRMENT IN BABOONS AFTER 1000 R OR LESS OF GAMMA RADIATION

AS REVEALED BY HEMORRHAGIC STRESS. Myers, J. H.; Blackwell, L. H.; Overman, R. R. (Univ. of Tennessee, Memphis). Radiat. Res.; 52: No. 3, 564-578(Dec 1972).

The present study demonstrated that the existence of radiation-induced impairment of cardiovascular function is disguised by a large hemodynamic reserve in nonhuman primates. These findings were revealed when the cardiovascular function of gamma-irradiated baboons was challenged with three transient bleeding episodes. Thirty baboons in five groups were treated as follows: one group was sham irradiated and the remaining four exposed to either 250, 500, 750, or 1000 R of single, whole-body gamma radiation (35 R/min). The cardiovascular system of each group was challenged at 2, 48, and 168 hr postirradiation with a bleeding episode that lasted approximately 10 min. Each challenge consisted of the rapid withdrawal and replacement of an estimated 43% (25 ml blood/kg body weight) of the baboon's blood volume. Hemodynamic function was assessed before and 30 min after each bleeding episode. The hemodynamic response to the first challenge appeared to be independent of radiation exposure. The greater variability in the response of gamma-irradiated groups to the second and third challenges, however, suggests evidence of a compensating but deteriorating cardiovascular system. (auth)

20108 PROMPT EFFECTS OF RADIATION ON THE HEART RATE OF MAMMALIAN EMBRYO. Norris, J. A.; Robkin, M. A.; Shepard, T. H.; Tanimura, T. (Univ. of Washington, Seattle). Radiat. Res.; 52: No. 3, 579-587(Dec 1972).

The prompt effects of radiation on the heart rates of 18 rat embryos were studied in vitro by culturing Sprague–Dawley rat embryos at day 11 of gestation in a circulating life support system. While in the life support system, the embryos were exposed to either 1316 ± 76, 1750 ± 101, or 2200 ± 127 R/min of 250 kVp x rays. The heart rates were continuously monitored and recorded from at least 15 min before the irradiation started until the heart rates dropped below 30 beats/min. Statistically significant changes in the heart rates during irradiation were found as measured by the slopes of the linear regressions. No statistically significant trend in the heart rates was observed until the onset of severe bradycardia. This response led to a cessation of the heartbeat in all embryos. After the initial stopping, 45% recovered heartbeats to an average level equal to 66% of the initial rate. The results suggest that there exists a total absorbed dose threshold and that the embryonic heart is more sensitive to the total absorbed radiation dose than to the radiation dose rates used in this experiment. (auth)

20109 POST-IRRADIATION CHANGES IN SALIVATION OF RATS WHOLE-BODY IRRADIATED WITH LETHAL DOSES OF X-RADIATION. Vodicka, I. (Vojensky Lekarsky Vyzkummy a Doskolovaci Ustav J. E. Purkyne, Hradec Kralove, Czech.). Sb. Ved. Pr. VLVDU Hradci Kralove; 60: 51-60(1972). (In Czech).

The secretion of saliva within one hour after the subcutaneous administration of pilocarpine (1 mg/kg b.w.) was studied in female rats prior to exposure and on the 4th day after whole-body x-irradiation with 300, 450, 600, and 750 R. The amount of saliva secreted was judged against the area of spots formed on the Whatman 3MM chromatographic paper where the barbital-anesthetized rats had been placed. The secretion on the 4th day after exposure was found to markedly decrease with an increasing exposure. The decrease was statistically significant. The maximum exposure applied, i.e. 750 R, resulted in 17.7% of the normal value. (auth)

20110 BASIC PROBLEMS IN THE PATHOGENIC ACTION OF IONIZING RADIATION. Gorizontov, P. D. Patol. Fiziol. Eksp. Ter.; No. 4, 6-13(1972). (In Russian).

Previous work on the effect of ionizing radiation on the mammalian organism is surveyed. Radiation sensitivity and damage of cells, problems of radiation damage to organisms, the recovery problem, the role of humoral factors in the recovery process, and the values of certain systems for varying the radiation sensitivity of the organism are discussed. A bibliography of 63 titles is appended. Results of 30-day irradiation of mice, cell damage in the thymus of rabbits and guinea pigs as a function of dosage, and the change in the number of thymus cells in rats under a dosage of 700 roentgens, are presented. (JPRS)

20111 RESPONSE OF RAT LIVER ENZYMES INVOLVED IN FATTY ACID SYNTHESIS TO INCREASING DOSES OF IONIZING RADIATION IN VIVO. McHale, C. G.; Catravas, G. N. (Armed Forces Radiobiology Research Inst., Bethesda, MD). Radiat. Res.; 52: No. 3, 545-552(Dec 1972).

The effect of various doses of x rays and of mixed neutron-gamma radiation on the fatty acid-synthesizing liver enzyme system in rats was investigated. It was found that the activity of this enzyme system first increased with radiation dose and then decreased in rats exposed to either x rays or mixed neutron–gamma radiation. Acetyl CoA carboxylase activity was found to be more sensitive to mixed neutron–gamma radiation (decreased) than to x rays, whereas fatty acid synthetase appeared to be more sensitive to x rays (increased) than to mixed neutron-gamma radiation. (auth)

20112 EXPERIMENTAL REORGANIZATION OF THE CEREBELLAR CORTEX. I. MORPHOLOGICAL EFFECTS OF ELIMINATION OF ALL MICRONEURONS WITH PROLONGED X-IRRADIATION STARTED AT BIRTH. Altman, J.; Anderson, W. J. (Purdue Univ., Lafayette, IN). J. Comp. Neurol.; 146: No. 3, 355-405(Nov 1972).

The heads of Long-Evans rats were irradiated from birth with a schedule of repeated doses of low-level x-ray, which prevented the acquisition of the postnatally-forming basket, stellate and granule cells. The absence of these microneurons led to several changes in the organization of the cerebellar cortex, studied at 30 days of age with light and electron microscopy. The somata of Purkinje cells were not strung out in a monolayer. Their primary dendrites were randomly oriented and arborized differently depending on the position of their somata in the depth of the cortex. Many Purkinje cell perisomatic processes, normally seen only in infants, were retained. Climbing and mossy fibers formed inconspicuous, symmetrical synapses with the somata and conspicuous, asymmetrical synapses with the perisomatic processes and dendritic thorns of Purkinje cells. Massive Purkinje cell dendrites with innumerable thorns made up much of the neuropil of the cortex. The dendritic thorns, in addition to forming true synapses, also established pseudosynapses with glial processes and synapses devoid of vesicles with the surface or the interior of Purkinje cell dendrites. The latter type of contact apparently led to autolysis of part of the dendrite, which was the only clear pathological phenomenon observed. These results indicated considerable autonomy in the growth of Purkinje cell dendrites, which arborized richly and sprouted innumerable small processes in the absence of parallel fibers, and formed postsynaptic dense membranes in contiguity with inappropriate processes, such as those of Purkinje cells or astrocytes. (auth)

20113 EFFECT OF TRIACETONEAMINE-N-OXYL ON OXYGENATION AND RADIOCURABILITY OF A MOUSE MAMMARY CARCINOMA. Olive, P. L.; Inch, W. R.; Sutherland, R. M. (Univ. of Western Ontario, London). Radiat. Res.; 52: No. 3, 618-626(Dec 1972).

The physiological effects of triacetoneamine-N-oxyl (TAN) were studied in C3H mice injected intraperitoneally with 0.05 to 0.60 mg TAN/g mouse. Doses greater than 0.15 mg/g caused bradycardia and a fall in deep body temperature; the duration and degree of effect were dependent on dose. Oxygen diffusion current within the C3HBA adenocarcinoma decreased rapidly after injection of TAN, indicating a reduction in blood flow, and returned slowly to initial values. Although TAN was shown to sensitize hypoxic cells in tissue culture to ionizing radiation, cure of the C3HBA tumor with x rays was not significantly different from controls when mice were injected with 0.05 or 0.25 mg TAN/g immediately before, or 0.25 mg TAN/g, 34 min before irradiation. (auth)

20114 RADIOGENIC CHANGES OF THE STRUCTURE OF THE ARTICULAR CARTILAGE. Zedgenidze, G. A.; Modyaev, V. P.; Ankina, M. A. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiol.-Radiother.; 13: No. 6, 637-650(1972). (In German).

In adult rabbits, the heterogeneity of the structure of the articular cartilage was shown by means of histology, electron microscopy, and histochemistry of mucopolysaccharides and on the basis of this seven structural layers were differentiated. A local irradiation with 900 rad did not only damage the cells but also the basal substance and the fibrous elements. The upper sections of the cartilage, transitional layer and layer of the isogenous groups, proved most sensitive to irradiation and that agrees with the opinion about a lower differentiation of these sections. There also began the restoration of the cartilaginous structure. The normalization of the histological structure of the articular cartilage took place after 30 days, some changes in the staining properties of the fibrous elements and disturbances in the metabolism of the acid mucopolysaccharides, however, remained. (auth)

20115 FUNCTIONAL AND MORPHOLOGICAL CHANGES OF THE LIVER AFTER ONE LOCAL IRRADIATION WITH ^{60}Co GAMMA RAYS ON THE HEPATIC REGION. Sveshnikov, A. A.; Bandurko, L. N.; Amosov, I. S.; Gileva, T. P.; Mardynskaya, V. P. Radiobiol.-Radiother.; 13: No. 6, 651-665(1972). (In German).

In experiments with rabbits after local irradiation of the whole hepatic region (field size 6 × 10 cm) or of a part of the liver (field size 3 × 5 cm), complex examinations of the function and structure of the liver were made: examinations were also made of the excretory, secretory, antitoxic and bile-secreting, and

albumin function of the liver and on the fermentative activity of blood serum and the morphological changes of the liver. For the judgement of the general condition of the animals, the peripheral blood and the dynamics of body weight were examined. The excretory function of the liver was found to react most sensitively to irradiation. Changes appeared at a dose of 400 rad. The albumin function was disturbed by a dose of 800 rad and the antitoxic function was disturbed by a dose of 1200 rad. In irradiation of the whole liver with a dose of 1200 rad and more, radiation sickness developed. In morphological examinations of the dead animals small necrotic focuses with lysis of the liver cells were found. A restoration of the disturbed functions began at the end of the 2nd and the beginning of the 3rd month, respectively. On the base of the examinations performed the minimum radiation dose causing irreversible changes was found to be 1200 rad in irradiation of the whole liver and 2000 rad in irradiation of a part of the liver. In further examinations, it has still to be cleared whether the shown changes are only the result of a direct damage or also the consequence of an indirect damage on the part of organs and tissues being irradiated together with the liver. (auth)

20116 INFLUENCE OF THE PLASMA COMPONENT OF THE HEMOSTATIC SYSTEM ON THE FUNCTIONAL PROPERTIES OF THE THROMBOCYTES, THE RESISTANCE OF THE VESSELS, AND THE PREDISPOSITION FOR BLEEDING IN RADIATION SICKNESS. Zhukova, N. A.; Ponomarev, Yu. T.; Shiryaev, V. V. (Inst. of Medical Radiology, Obninsk, USSR). Radiobiol.-Radiother.; 13: No. 6, 667-674(1972). (In German).

In experiments on Wistar rats, guinea pigs, and chinchilla rabbits it was found that on the culminating point of radiation sickness the intravenous injection of plasma without thrombocytes of normal animals (3.3 ml/kg body weight) increased the ability of the thrombocytes of attachment and aggregation and prevented the destruction of the formed thrombocyte aggregates. If one fourth of the starting value of thrombocytes are present in the blood circulation, the resistance of the arterial walls is increased and the bleeding time is decreased by the transfusion after about 60 minutes. The resistance of the arterial walls of irradiated animals was increased by intravenous injection of a thrombocyte plasma suspension; an injection of washed thrombocytes, however, had no effect. The plasma component takes part in the maintenance of the resistance of the arterial walls. Its influence is mediated by the thrombocytes. (auth)

20117 PROCESSES OF INJURY AND RESTORATION WITH FRACTIONATED SOFT AND HARD X-IRRADIATION. Libermann, A. N.; Krisyuk, E. M.; Sakovskaya, M. S. Radiobiol.-Radiother.; 13: No. 6, 681-689(1972). (In German).

The tendency for changes of the biological effectiveness of soft x rays (10.2 keV) in the transition of single treatment to long-lasting fractionated irradiation with relatively small doses was studied in white rats. The fractionated treatment was done in intervals of 48 hrs with doses making up $1/5-1/20$ of $LD_{50/30}$ for single irradiation per sitting. A linear dependence exists between the dose per sitting and the logarithm of the average duration of life of the irradiated animals. With the decrease of single doses in fractionated irradiation, the biological effectiveness of soft x rays decreases with respect to the duration of life, to the dynamics of body weight, and to the power of resistance of the animals to physical stress compared with the effect of hard x rays by one half up to one third. This decrease of the relative effectiveness of soft x rays is mainly to be explained by an essentially smaller portion of the irreversible damage. (auth)

20118 POSTNATAL CHANGES FOLLOWING CONTINUOUS PRENATAL IRRADIATION IN THE ALBINO MOUSE. Landolt, C. D. Jr. College Station, TX; Texas A and M Univ. (1972). 99p. University Microfilms Order No. 73-3549.

Thesis (Ph. D.).

Seventy-five recently bred female albino mice in groups of 25 each were exposed to gamma irradiation continuously throughout the 10-day period from day 6 through day 15 of gestation at rates of 43.5, 78.1, and 112.5 R/day, respectively. The offspring prenatally exposed to 435 R during the 10-day period were maintained for 51 weeks of postnatal life. The birth weights of the animals irradiated with 435 R were significantly reduced, as were the total-body weights at all stages of the postnatal period. No change in postnatal mortality was detected. Organ weights and organ-weight/body-weight ratios of the brains, livers, spleens, adrenals, testes, and ovaries-oviducts-uteri combinations of the sacrificed survivors were significantly reduced. Gonadal development was drastically impaired, and many cases of bilateral and unilateral microphthalmia were found in the prenatally irradiated adults. Early deficits in emotionality and locomotor coordination were detected in the mature prenatally irradiated mice, but these deficits disappeared in later life. The animals exposed to 781 R during the irradiation period were stillborn, and their birth weights were greatly reduced. Their brain sizes and cortical cellular packing densities were reduced, and neuronal staining properties were strikingly changed. Their gonadal development was greatly impaired, and splenic leucocyte production was abnormally low. No animal exposed to 1125 R during the irradiation period completed fetal development. (Diss. Abstr. Int., B)

20119 OXYGEN IN THE URINE OF IRRADIATED RATS WITH AN ADRENAL DEFICIENCY. Vlasenko, S. P. Biol. Zh. Arm.; 25: No. 3, 57-62(Mar 1972). (In Russian).

The adrenal gland was removed from male white rats 130 to 160 g in weight; on the fifth day after the operation, they were given a 750 R dose of x rays. At intervals of five to seven days the urine oxygen was determined by the method of B. L. Brin. The suppressing effect of the ionizing radiation on the oxidizing processes in the animal was greatly increased by the prior removal of the adrenal gland. (KSW)

20120 MODIFICATIONS IN THE CATALASE SYSTEM OF X IRRADIATED ($DL_{100}15$) RATS. Stefan, M.; Gheorghe, N. Rev. Roum. Physiol.; 9: No. 6, 501-505(1972). (In French).

The activity of catalase was studied in the liver, blood, and bone marrow of rats given x radiation in doses of approximately 700 R. The results demonstrate significant modifications in all three tissues without return to the normal state within ten days after irradiation. Simultaneously the radioprotective efficiency of a pyrimidine derivative (CFP_9) was studied with regard to its effect on the survival curve and on modifications of the enzyme activity. Although administration of the radioprotector before as well as after irradiation distinctly increased survival, no effect was observed on the level of the catalase system. (tr-auth)

20121 X-RAY-INDUCED SPECIFIC-LOCUS MUTATION RATES IN NEWBORN AND YOUNG MICE. Selby, P. B. Knoxville, TN; (Univ. of Tennessee (1972)). 98p. University Microfilms Order No. 73-2492.

Thesis.

The specific-locus mutation frequency resulting from 300 R of acute x irradiation was determined for the germ cells present in male mice at 0, 2, 4, 6, 8, 10, 14, 21, 28, and 35 days of age and also for the female mice at 0 days of age. Sample size was much larger for the males irradiated on day 0 than for other age groups but in all groups it was large enough to insure that an extremely high rate would be noticed. At 35 days of age the testis is histologically similar to that of the adult. It was important to know if the germ cells present in immature mice yield the same mutation frequency as those in the adult. The mutation frequency is only 1.2 as high in the day-0 male as it is in the similarly irradiated adult male, this difference being statistically significant. Taken together, the remaining nine groups of males have an average mutation frequency similar to that of the adult. None of the nine groups has a mutation rate statistically significantly higher than the adult. There is a statistically significantly higher incidence of both permanent sterility and clusters of mutations following irradiation of day-0 males than is found for similarly irradiated adults. Both of these results would be expected if there are relatively fewer surviving germ cells following irradiation of the day-0 testis. The mutation frequency per R is only $1/5$ as high for the females irradiated with 300 R on day 0 as it is for adult females exposed to 400 R, the nearest dose used, this difference in rate being highly statistically significant. The reproductive capacity of the females irradiated on day 0 is about $1/3$ that of control females. (Diss. Abstr. Int., B)

20122 EFFECT OF PARA-AMINOMETHYLBENZOIC ACID ON THE POST IRRADIATION DISTURBANCE OF HAEMOCOAGULATION IN DOGS AFTER WHOLE-BODY EXPOSURE TO 600 R. Pospisil, J.; Skala, E.; Vranovska, J.; Dienstbier, Z. (Charles Univ., Prague). Strahlentherapie; 144: No. 6, 728-736(Dec 1972).

The administration of p-aminomethylbenzoic acid to whole-body irradiated (600 R) dogs from the 8th to the 18th day at a dose of 0.6 g/kg per day (every 8 hours separately) insignificantly improved the post-irradiation disturbance of haemocoagulation. p-Aminomethylbenzoic acid administered 2 hours (dose 100 mg/kg) before whole-body irradiation of mice (900 rd) had no radioprotective effect. In contrast, if N-acetyl-PAMBA was administered in the same way 2 hours before whole-body irradiation (700 R), an increased mortality was observed. Administration of p-aminomethylbenzoic acid i.p. 5 days (dose 100 mg per day) from the day of irradiation did not influence the post-irradiation mortality. Administration of p-aminomethylbenzoic acid per os at a dose of 100 mg/kg/day from the day of irradiation did not show any statistically significant effect on the post-irradiation mortality. In vitro EACA and AMCA inhibited the effect of pepsin, cathepsine, and trypsin; this effect was of less significance with PAMBA. (auth)

20123 INVESTIGATION OF THE INFLUENCE OF ABNORMAL CELL GROWTH ON THE CRYPT CELL POPULATION KINETICS IN THE IRRADIATED INTESTINAL EPITHELIUM. Kononenko, A. M. (Central Research Inst. of Roentgenology and Radiology, Leningrad). Tsitologiya; 14: No. 10, 1228-1232(Oct 1972). (In Russian).

The cell population of the intestinal epithelium cannot be in a steady state at any constant value of the mitotical activity of its proliferative pool. It is possible to establish theoretically the upper limit of the mitotic activity at which the intestinal epithelium population is to pass through the indefinite growth. This level is lower the higher the proliferative cell biomass. On the other hand, crypt depopulation may be achieved due to the cessation of mitotic activity. Thus, the abnormal cell growth may destabilize the cell population. The fact that in the irradiated intestinal epithelium the cell size has tendencies to change opposite to the alterations in the number of crystal cells and to their mitotic activity may suggest that the changes in the biomass of proliferative cells may be a factor regulating the cell population and providing the negative feedback between the number of crypt cells and their mitotic activity. (auth)

20124 DISCRIMINANT ANALYSIS OF THE RELATIONSHIP BETWEEN RADIATION DOSE AND BLOOD LEUKOCYTE VALUES IN THE PAN IRRADIATED RAT. Martinenghi, C.; Bergonzi, M.; Riccardi, A.; Comotti, L. (Univ., Milan). Radiol. Med.; 58: No. 6, 505-515(Jun 1972). (In Italian).

Granulocyte and lymphocyte counts were made in 162 Sprague Dawley rats from 3 to 768 hr after whole-body gamma irradiation with 30 to 1400 R. Variations observed in the first 12 hr were subjected to discriminant analysis and showed that individual animals could be assigned to one of three exposure ranges (high, medium, and low) with an error of not more than 10%. (auth)

20125 INFLUENCE OF EXTREME FACTORS ON THE STRUCTURE OF ORGANS AND TISSUES. Prives, M. G.; Mikhailov, S. S. Moscow; Meditsina (1972). 96p. (In Russian).

A collection of 16 papers given at the Leningrad International symposium for anatomists in 1970 on the subject of extreme factors encountered in high-altitude and cosmic flights and their effects on the organism is presented. Gravitational stresses and radiation effects on principally rats and rabbits were reported. One paper deals with the carbohydrate and protein exchange in the digestive organs of rabbits during the combined actions of vibration, acceleration, and radiation (90 R, source not specified). A second paper was devoted to a histological analysis of the influence of several extreme factors on post-radiation changes in the tissues of rats. In this case the radiation treatment consisted of 120 MeV proton exposure or gamma-neutron irradiation. (KSW)

20126 APPLICATION OF A FAST-NEUTRON FACILITY IN AN ARGONAUT REACTOR FOR RADIOBIOLOGICAL RESEARCH. Davids, J. A. G. (Reactor Centrum Nederland, Petten). pp 27-40 of Radiobiological Applications of Neutron Irradiation. Vienna; International Atomic Energy Agency (1972).

From Meeting on radiobiological applications of neutron irradiation; Vienna, Austria (6 Dec 1971). See STI/PUB-325; CONF-711204.

Use of a converter facility in an Argonaut reactor for irradiation of biological specimens with high-LET fast neutrons is described. Small to medium-sized animals can be exposed to a fairly pure fast-neutron flux that is uniform over a large area. The neutron spectrum was determined by proton-recoil spectrometry and by measuring the fission rates of the threshold detectors ^{232}Th, ^{237}Np, and ^{238}U. The mean neutron energy is 1.04 MeV. Forty mice may be irradiated simultaneously at the same fast-neutron centreline dose rate up to 10 rad/min at the maximum reactor power of 10 kW. The absorbed dose distribution in monkeys during rotational exposure was studied with a tissue-equivalent phantom. Neutron RBE values were determined for several biological endpoints. In mice of the same strain survival curves of haematopoietic stem cells and intestinal-crypt stem cells exposed to either fast neutrons or x rays were compared. With both types of radiation the haematopoietic stem-cell population is the most radiosensitive. The difference in RBE factors for bone marrow and intestinal syndromes is determined by an equal RBE difference for the initial stem-cell damage in the two tissues. (auth)

20127 IN VIVO DETERMINATION OF RBE FACTORS OF 15-MeV NEUTRONS FOR DIFFERENT BIOLOGICAL EFFECTS IN NORMAL TISSUE AND SARCOMA 180, USING CELL LABELLING WITH ^{125}I-DEOXYURIDINE. Porschen, W.; Feinendegen, L. E. (Kernforschungsanlage GmbH, Juelich, Ger.). pp 121-34 of Radiobiological Applications of Neutron Irradiation. Vienna; International Atomic Energy Agency (1972).

From Meeting on radiobiological applications of neutron irradiation; Vienna, Austria (6 Dec 1971). See STI/PUB-325, CONF-711204.

To elucidate the possible advantages of fast neutrons in comparison to low LET radiation the knowledge of the RBE values for both normal and malignant tissues is of interest. These factors were determined by measuring externally the incorporation of ^{125}I-deoxyuridine into tumour and whole-body DNA. White mice were irradiated with either γ rays or with D-T neutrons. At various time intervals after irradiation 2 μCi ^{125}IUdR were injected into the tail vein. Two days after injection the whole-body retention of ^{125}I was measured and compared with controls. The rate of incorporation pertaining chiefly to proliferating cells in bone marrow and gastro-intestinal tract varied with the time after irradiation. The effects are typical for each type of irradiation and permit evaluation of RBE factors for different biological endpoints. Sarcoma 180, transplanted in the right hind leg of white mice, was used to determine the RBE factors for the rates of radioinduced cell loss and radioinduced depression of DNA synthesis. Following pulse labeling with ^{125}IUdR the ^{125}I incorporation into the solitary tumour was determined with a scintillation counter permitting shielding of the whole body. Under normal conditions Sarcoma 180 shows a cell loss rate of about 0.5% per hour. Irradiation with 15-MeV neutrons or γ rays results in a dose-dependent increased rate and duration of cell loss. Also the incorporation rate of ^{125}IUdR is depressed as function of dose and LET. (auth)

20128 RBE VALUES FOR LENS OPACIFICATION IN MICE EXPOSED TO A 400-MeV NEUTRON BEAM. Di Paola, M. (CNEN, Rome); Bianchi, M.; Baarli, J. pp 147-67 of Radiobiological Applications of Neutron Irradiation. Vienna; International Atomic Energy Agency (1972).

From Meeting on radiobiological applications of neutron irradiation; Vienna, Austria (6 Dec 1971). See STI/PUB-325; CONF-711204.

A radiobiological collaborative experiment between CNEN and CERN was undertaken to obtain information on the induction of lens opacification in mice exposed to the 400-MeV neutron beam from the CERN 400-MeV synchrocyclotron. The mice were exposed head on in the pure beam and behind a 20 g/cm^2 Polythene attenuator where the maximum dose build-up occurred. The dose measurements were made with a tissue-equivalent parallel-plate ionization chamber. The 822 male mice, F1 hybrids between C54Bl and C3H inbred strains, were of an average age of 75 days at the time of exposure. After irradiation serial examinations with a slit-lamp microscope were performed. A particular method was used to quantify the degree and the extent of the early opacities of the posterior subcapsular region of the lens. Preliminary results are presented of the observations from the first 20 months after exposure. By comparison with 250-kVp x rays these results give RBE values of 5.75 for the pure beam and about 2 for the attenuated beam. (auth)

20129 PROGRAM TO STUDY FISSION NEUTRON-INDUCED CHRONIC INJURY IN CELLS, TISSUES, AND ANIMAL POPULATIONS, UTILIZING THE JANUS REACTOR OF THE ARGONNE NATIONAL LABORATORY. Grahn, D.; Ainsworth, E. J.; Williamson, F. S.; Fry, R. J. M. (Argonne National Lab., IL). pp 211-28 of Radiobiological Applications of Neutron Irradiation. Vienna; International Atomic Energy Agency (1972).

From Meeting on radiobiological applications of neutron irradiation; Vienna, Austria (6 Dec 1971). See STI/PUB-325; CONF-711204.

Biological studies utilizing the JANUS reactor will be an integrated series of experiments whose object will be to define basic cellular and tissue mechanisms of chronic radiation injury and thereby permit more precise prediction of the consequences of occupational or accidental exposure to ionizing radiation. A primary requirement will be to obtain data on long-term radiation injury in terms of: cell injury and recovery, tissue and organ injury, repair, and regulation; and the actuarial statistics of disease and death. Data will be obtained for tumour incidences, with emphasis on early and late life leukemias and lymphomas and on the presence of degenerative and infectious diseases. Most of the studies will involve large populations of small laboratory animals, principally mice. During the next three to ten years the specific risks attributable to neoplastic diseases compared to all other causes of death should be determined and the presence of any specific injury component due to neutron irradiation defined. Questions concerning neutron dose additivity, dose fractionation pattern, total dose and dose rate should be resolved for the late effects of radiation injury at both tissue and organism levels. Specific radiation-induced pathology will be analysed in terms of death rates differentiated from control. If a high degree of neutron dose additivity should be observed, precise extrapolation of late radiation effects from moderate

dose levels to extremely low dose levels can be accomplished with both statistical and economic advantages. (auth)

20130 STUDIES ON THE PHAGOCYTIC FUNCTION OF RAT BONE MARROW AFTER WHOLE-BODY IRRADIATION. II. Phagocytic Capability of Bone Marrow Reticular Cells in Starved Rats. Antonijevic, M.; Dragic, M. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Strahlentherapie; 144: No. 5, 607-613(Nov 1972).

Continuing the investigations of the effects of whole-body-irradiation on the phagocytic function of the bone marrow, these examinations were undertaken in order to see to what extent the phagocytic capability of bone marrow reticular cells could be changed if the rats were irradiated under conditions of acute starvation. The animals were deprived of food for four days and then irradiated with 200, 600, and 800 R, respectively. The phagocytic capability was examined using carbon test at 1, 2, 4, 7, and 10 days after irradiation. It was found that the phagocytic activity of reticular cells was stimulated during the first four days following irradiation. In comparison with the normally fed rats exposed to the equal irradiation doses, the magnitude of the phagocytic response was nearly the same. However, we may not neglect the fact that acute starvation induced hypocellularity so that the starved rats were submitted to irradiation with a decreased number of all types of the bone marrow cells including reticular cells. (auth)

20131 PRENATAL FRACTIONATED X-IRRADIATION AND CHEMICAL RADIATION PROTECTION. Baev, I.; Bairakova, A.; Benova, D. (Research Inst. of Radiology and Radiation Hygiene, Sofia). Strahlentherapie; 144: No. 4, 477-482(1972).

Gravid female rats were exposed throughout gestation to a total dose of 800 R x-rays given in fractions of 40 R 24 hours apart under cysteamine or cystamine protection. Irradiated offspring obtained were placed with intact lactating stepmothers and followed-up to adult age with regard to litter size, postnatal death rate, and changes in body weight. For mean litter size as well as body weight, protection was clearly afforded by both cysteamine and cystamine. As to postnatal death rate, no protective effect was observed. (auth)

20132 DOSE MEASUREMENT IN ANIMAL EXPERIMENTS. II. Dose Distribution in ^{60}Co Irradiated Pigs. Novotny, J.; Otoupal, P.; Mika, J.; Hrusovsky, J. (Dept. of Dosimetry, Prague). Strahlentherapie; 144: No. 4, 430-434(Oct 1972).

The use of LiF thermoluminescent and glass radiophotoluminescent dosimeters for measurement of absorbed doses in animal experiments is discussed. The doses absorbed at 36 points in the cadavers of pigs irradiated with ^{60}Co were measured using LiF TLD. The homogeneity of irradiation for five weight groups of pigs as well as the dose distributions within the bodies of the pigs were established. (auth)

20133 RADIATION-INDUCED CHANGES IN THE ACTIVITIES OF ALKALINE RIBONUCLEASE AND RIBONUCLEASE INHIBITOR IN RAT THYMUS SUPERNATANT FRACTION. Patil, M. S.; Saroja, S.; Sreenivasan, A. (Bhabha Atomic Research Centre, Trombay, India). Strahlentherapie; 144: No. 5, 602-606(Nov 1972).

Free and total activities of alkaline ribonuclease (RNase) (pH optimum 7.8) were assayed in the rat thymus supernatant fraction at 4, 18, and 48 hr following whole-body x irradiation of 600 R. Both the free and total activities were observed to be increased and the increase was progressive with time following irradiation. Concomitant with the activation of the enzyme, a decrease in the alkaline RNase inhibitor activity in the supernatant was found at all the time intervals studied. The inhibition was 15, 31, and 64% at 4, 18, and 48 hr, respectively. (auth)

20134 ELECTRON OPTICAL INVESTIGATIONS ON THE INFLUENCE OF A WHOLE-BODY X-RAY IRRADIATION WITH 400 R ON THE FINE STRUCTURE AND PHAGOCYTIC FUNCTION OF THE EPITHELIAL CELLS IN THE EGG MEMBRANE OF RATS. Franke, H.; Walter, D.; Goetze, E. (Friederich-Schiller Univ., Jena, Ger.). Strahlentherapie; 144: No. 4, 435-444(Oct 1972). (In German).

Wistar rats were exposed to a single total body irradiation at a dose of 400 R at day 17 of pregnancy. Forty-eight hours post x-irradiation the fine structure and the micropinocytosis of ferritin by the yolk sac epithelial cells were examined. In nonirradiated animals the intrauterine injection of ferritin caused a marked storage of ferritin molecules in numerous, very electron dense phagosomes of various size. After irradiation at 400 R there was a nearly complete inhibition of pinocytosis. The phagosomes in the yolk sac epithelium were significantly diminished or completely absent, a part of the epithelial cells contains accumulations of dense bodies, possibly representing lysosomes or phagolysosomes, most of them are free of ferritin. Furthermore, it is generally noticed that most of the different cell organelles in the visceral yolk sac epithelium despite the sublethal dose are remarkably damaged; besides this the content of lipid droplets in the hyaloplasm is abnormally high. The electron microscopic findings give evidence that the strong reaction of the epithelium cells is due to an irradiation provoked release of lytic enzymes from the lysosomes, which in the epithelial cells of the yolk sac are present at any time. (auth)

20135 INFLUENCE OF HYPOTHERMIA ON THE MITOCHONDRIA IN THE DUODENAL CELLS OF WHOLE-BODY IRRADIATED RATS. Electron Optical Investigations in the Early Phase after Irradiation. Haegele, D.; Skoluda, D. (Institut fuer Allgemeine und Experimentelle Pathologie, Mainz). Strahlentherapie; 144: No. 4, 445-450(1972). (In Geramn).

The protective effect of hypothermia during total lethal x-ray radiation was demonstrated electron microscopically on the duodenal epithelium of Wistar rats. This protective influence of hypothermia could already be observed in the early stages of radiation. The possible origins of this phenomenon are discussed. (auth)

20136 ADENOSINE-NUCLEOTIDES AND RADIOSENSITIVITY. Langendorff, H.; Langendorff, M. (Heiligenberg Institut fuer Experimentelle Biologie, Ger.). Strahlentherapie; 144: No. 4, 451-456(1972). (In German).

The effect of various adenosine-nucleotides on the radiosensitivity of female mice was tested. In every case by prophylactic administration of these substances a greater $LD_{50/30\,days}$ after x-ray irradiation of the experimental animals and a higher dose reduction factor were observed than in the controls. The analysis of the results is based on the hypothesis that in applying chemical substances which influence the radiosensitivity of a higher differentiated organism, the mode of action found by Sutherland is of greatest importance. (auth)

20137 EXOGENOUS PEROXIDASE LOCALIZATION IN IRRADIATED ARTERIES. Hampton, J. C.; Rosario, B.; Adee, R. R. (Battelle Northwest Lab., Richland, WA). AT(45-1)-1830. pp 8-9 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

20138 ULTRASTRUCTURAL INVESTIGATION OF THE LIGHT FLASH PHENOMENON SEEN BY OUR ASTRONAUTS. Philpott, D. E.; Corbett, R.; Black, S.; Turnbill, C. (Ames Research Lab., Moffett Field, CA). pp 52-53 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

20139 GREAT INCREASE OF NUMBERS OF VIRUS PARTICLES BY IRRADIATING C3H MOUSE MAMMARY TUMORS TRANSPLANTED INTO MALE MICE. Melnick, P. J.; Cha, J. W.; Samouhos, E. (Veterans Administration Hospital, Martinez, CA). pp 272-273 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

20140 TOTAL AND LOCAL CIRCULATION CHANGES IN RABBITS FOLLOWING CYSTAMINE ADMINISTERED INTRAVENOUSLY IN A RADIOPROTECTIVE DOSE. Kuna, P. (Purkyne Medical Research Inst., Hradec Kralove, Czech.). Strahlentherapie; 144: No. 4, 483-490(1972).

In rabbits total and local cardiovascular parameters following an infusion of a radioprotective dose of cystamine-2 HCl (100 mg/kg) were determined. Hypotension, bradycardia, and depressed respiration during the cystamine 5 minutes infusion gradually escaped in the next 30 minute period. The rise of cardiac output and stroke volumn with decrease of peripheral resistance was observed at the end of, and 10 and 30 minutes post infusion. No changes in hematocrit and blood volume were found. Immediately after the end of the infusion the blood flow through the radiosensitive organs decreased, in the spleen significantly. At later time intervals the blood supply to these organs was within the range of controls. (auth)

20141 EFFECTS OF IONIZING RADIATION ON THE IN VIVO METABOLISM OF MONOCARBON FRAGMENT PRECURSORS TO CO_2. Ngo, T. M.; Winchell, H. S. (Univ. of California, Berkeley). pp 116-127 of Frontiers of Nuclear Medicine. Horst, W. (ed.). New York; Springer Verlag (1971).

These results show a decrease of the initial rate and amount of $^{14}CO_2$ excretion in the breath of rats given various doses of x rays following the intravenous administration of L-methionine-CH_3-^{14}C and ^{14}C-formate. No significant alteration in $^{14}CO_2$ production was noted in irradiated rats following the intravenous injection of either L-glycine-1-^{14}C or L-serine-3-^{14}C. The present study is a further evaluation of our previous finding that ionizing radiation suppresses the turnover rate of the monocarbon fragments regardless of the source of the monocarbon unit by inactivation of tetrahydrofolic acid or the enzymatic processes responsible for its production. The radiation effect on the monocarbon pool may present a clinically significant metabolic defect following exposure to ionizing radiation since the availability of monocarbon fragments is required for a large number of critical life processes, such as the production of purines and thymidine in nucleic acid synthesis. (auth)

20142 ACTIVITY OF HEXOKINASE AND CHOLINESTERASE IN THE BRAIN AND HEART OF RATS UNDER THE EFFECT OF RELATIVELY LOW DOSES OF SYSTEMIC FRACTIONAL X IRRADIATION. Kukulyanskaya, M. F.; Khripchenko, I. P. Vestn. Beloruss, Gos. Univ., Ser. 2; No. 1, 43-46(1972). (In Russian).

The activity of hexokinase and cholinesterase in homogenates of the brain and heart of intact and adrenalectomized rats was determined on the first, third, and seventh day after systemic fractional x-ray exposure to a total dose of 40 roentgens. On the seventh day after irradiation, the activity of hexokinase and cholinesterase in the brain decreased, while the corresponding activity for the heart increased. Irradiation of the adrenalectomized rats caused a slight increase in the activity of these enzymes in the brain and heart muscle. (JPRS)

20143 FUNCTIONAL HETEROGENEITY OF MURINE LYMPHOID CELLS. IV. Allogeneic Mixed Lymphocyte Reactivity and Cytolytic Activity as Functions of Distinct T Cell Subsets. Stobo, J. D.; Paul, W. E.; Henney, C. S. (National Institutes of Health, Bethesda, MA). J. Immunol.; 110: No. 3, 652-660(Mar 1973).

Murine thymus-derived (T) cells may be divided into two distinct subgroups on the basis of differences in their relative density of the T differentiation antigen theta (θ), differential responsiveness to the T dependent mitogens phytohemagglutinin (PHA) and concanavalin A (Con A) as well as by differences in recirculation patterns and radiation sensitivities. Thus, among splenic lymphocytes one population of T cells bears a relatively high density of θ determinants, demonstrates relatively equal responsiveness to PHA and to Con A, resides within the recirculating pool of lymphocytes and is relatively radiation sensitive. Another population of splenic T cells bears a relatively reduced density of θ determinants, demonstrates reactivity predominantly to Con A and belongs to a sessile, radiation resistant lymphocyte pool. The ability to delineate T cell subgroups by these characteristics provides a useful means of investigating the functional characteristics of T cell subsets. It is demonstrated that T cells from the spleens of nonimmunized mice, which are reactive in one-way allogeneic mixed lymphocyte cultures (MLC) belong to a T cell subset distinct from that population of T cells, present in spleens of immune mice, which is capable of lysing allogeneic cells. Thus, the administration of limiting amounts of anti-thymocyte serum (ATS) or sublethal irradiation to normal C57BL/6 mice removes the recirculating, radiation sensitive population of cells. The residual spleen T cell population does not manifest mixed lymphocyte reactivity to (C57BL/6 × BALB/c) F_1 spleen cells. On the other hand, the cytolytic activity of spleens from alloimmunized C57BL/6 mice is unaffected by these treatments. Irradiation or ATS treatment before immunization, however, completely ablates the development of cytolytically active splenic lymphocytes. Thus, although the MLC reactive cells and the cytolytically active cells belong to different splenic T cell populations, the MLC cell appears to be required to generate cytolytic activity. Possible mechanisms to explain this requirement are presented. (auth)

20144 RESISTANCE OF IRRADIATED F_1 HYBRID AND ALLOGENEIC MICE TO BONE MARROW GRAFTS OF NZB DONORS. Lotzova, E.; Cudkowicz, G. (State Univ. of New York, Buffalo). J. Immunol.; 110: No. 3, 791-800(Mar 1973).

Heavily irradiated mice of several inbred and F_1 hybrid strains were classified as resistant or susceptible to allogeneic or parental grafts of 10^6 NZB bone marrow cells depending on the 5-day hemopoietic repopulation of host spleens. Several strains did not support the growth of donor cells despite total-body irradiation. NZW × NZB F_1 mice resisted the growth of as many as 4×10^7 parental cells, the strongest barrier ever observed in mice for marrow transplants. The failures of growth were due to host-anti-graft reactions depressible by pretreatment of recipients with cyclophosphamide or horse anti-mouse thymocyte serum. Analysis of the progeny of two separate backcrosses of F_1 mice to NZB indicated that two nonlinked autosomal genes controlled resistance. One of these genes was in linkage group IX, 31.42 crossing-over units away from the D end of H-2, specifying or controlling the expression of alloantigen-like components of hemopoietic cells (Hh-gene). The second gene had an epistatic effect, probably by regulating the recognition of, or the reactivity to, Hh-gene products. (auth)

20145 EFFECT OF IN VIVO IRRADIATION ON MACROPHAGE FUNCTION. Schmidtke, J. R.; Dixon, F. J. (Scripps Clinic and Research Foundation, La Jolla, CA). J. Immunol.; 110: No. 3, 848-854(Mar 1973).

In vivo irradiation (660 R) of donor mice before removal of their peritoneal macrophages caused activation of these cells as indicated by increases in lysosomal enzymes but did not significantly affect the manner in which these cells handled keyhole limpet hemocyanin (KLH) in comparison to how macrophages from unirradiated donors handled KLH. The parameters measured included uptake, catabolism, retention, and amount of membrane-bound KLH. In syngeneic recipients, however, the immunogenicity of equal amounts of KLH associated with activated macrophages from irradiated donors was significantly increased compared to that of KLH associated with macrophages from unirradiated donors. Also, addition of activated non-KLH-containing macrophages to the inoculum of normal KLH-containing macrophages increased the immune response. Infection of mice with lactic dehydrogenase virus also enhanced the immunogenicity of KLH associated with macrophages from these mice compared to control, uninfected mice. (auth)

Invertebrates

20146 DEVELOPMENTAL EFFECTS OF IONIZING RADIATION IN AEDES AEGYPTI. Asman, Monica; Rai, K. S. (Univ. of Notre Dame, IN). Contract (11-1)-38). J. Med. Entomol.; 9: No. 5, 468-478(30 Sep 1972). (COO-38-482).

All stages of Aedes aegypti were exposed to radiation in doses ranging from 500 to 32,000 R. A 10,000 cu ^{60}Co source, delivering approximately 125 R/min., was used to determine the radiosensitivity relating to egg hatch, growth and development, viability to adulthood, longevity, cell division, as well as fecundity and fertility in both sexes. Fully embryonated eggs exposed to 500 R resulted in retarded development of larvae hatching from them but proved to be more radioresistant than eggs undergoing embryonation. Prolonged developmental time was related to a decrease in mitotic rate. The greater sensitivity of the 1st 3 larval stages over embryonated eggs appeared to be due to mitotic activity in the larval stages and its absence in quiescent eggs. Damage on the whole was directly proportional to dose and indirectly proportional to the stage of development reached; e.g., adult longevity was decreased when young larvae were exposed to 500 R, and when pupae and adults received 8000 R or more. The reproductive systems of both sexes were highly sensitive but fecundity and fertility were not affected to the same extent in the two. While treatment in all stages retarded or completely inhibited gonadal development and function, a low dose of 500 R to females in the 1st instar initiated a statistically significant increase in egg fecundity. Female sterility was achieved with a lack of fecundity at exposures of 4000 R to pupae and adults. Male sterility was related to production of infertile sperm at exposures of 8000 R. Cytological studies of gonads in control and treated organisms provided evidence for the observed radioinduced decrease in reproductive potential. (auth)

20147 RADIATION BIOLOGY OF THE GREATER WAX MOTH (GALLERIA MELLONELLA (L)): EFFECTS ON DEVELOPMENTAL BIOLOGY, BIONOMICS, MATING-COMPETITIVENESS AND F_1 STERILITY. Nielsen, R. A. Logan, UT; Utah State Univ. (1971). 154p. University Microfilms Order No. 73,908.

Thesis (Ph. D.).

Males and females of the greater wax moth were irradiated with gamma rays during various ages of eggs, larvae, pupae, and adults. Survivors were mated with untreated moths and spermatophore transfer, oviposition, egg hatch, and adult development were studied. The F_1 progeny were also mated to untreated moths and similar observations made. Males from selected irradiated and F_1 groups were tested for mating competitiveness with untreated males. Females were more sensitive to irradiation than males, and fewer females than males developed to the adult stage in both the irradiated and the F_1 generation. Irradiation of either parent during the egg or larval stages tended to inhibit egg fertilization,

while irradiation during the pupal or adult stages tended to cause lethality to the F_1 embryos. Irradiated females transmitted more lethal effects to the F_1 generation than irradiated males. The F_1 males transmitted more lethal effects to the F_2 generation than the F_1 females regardless of which parent of the F_1 generation was irradiated. The F_1 males of irradiated males transmitted more lethal effects to the F_2 generation than the F_1 males of irradiated females. The F_1 males were generally less fecund than the irradiated parent. No eggs hatched from untreated females mated to the F_1 sons of male parents irradiated as 0 to 1 day, 3 to 4 day, or 6 to 7 day pupae at 4, 4, and 16 kilorads, respectively, or as adults at 16 kilorads. Their eggs usually developed an embryo before death, but some were nonembryonated when the male parents were irradiated as 6 to 7 day pupae or adults. Females mated to the F_1 sons of male parents irradiated as last instar larvae or adults received significantly more spermatophores than those of the control. No such effect was noted when the parent was irradiated during other developmental stages. Males irradiated as eggs or larvae at sterilizing dosages competed poorly with untreated males for mates, and females placed with them mated repeatedly until they mated with a normal male. Males irradiated as 3 to 4 day, and 6 to 7 day pupae at sub-sterilizing dosages of 6, 9, and 16 kilorads were not fully competitive with normal males for mates. However, their F_1 sons were highly competitive, and accomplished 81 to 92% of the matings in tests in which 50% was presumed to indicate full competitiveness. The results of this research suggest two possible methods of controlling the greater wax moth by the use of irradiated insects. One method would be to release sub-sterilized moths that would transmit the deleterious effects of the irradiation to subsequent generations and cause widespread decreased fecundity. A second method would be to irradiate insects at a substerilizing dosage that was sufficiently large to induce sterility in the F_1 progeny. (Diss. Abstr. Int., B)

20148 EFFECT OF THE INDENE PREPARATION F-11 ON THE FREQUENCY OF RECESSIVE LETHALS IN THE SEXUAL CELLS OF DROSOPHILA IRRADIATED BY X RAYS. Eliseeva, K. R.; Mase, I. B.; Rakitski, P. F. (Inst. of Genetics and Cytology, Minsk). Vestsi Akad. Navuk BSSR, Ser. Biyal. Navuk; No. 1, 68-74(1973). (In Belorussian).

The joint action of preparation F-11 and radiation on the output of recessive lethal mutations in Drosophila melanogaster indicated that the modifying action of the substance depended on the stage of development of the sex cells. In reinforcing the radiosensitivity of the mature sperm the preparation showed a reliable protective effect at spermatid and spermatogonium stages. The method of introducing the preparation into the organism has little effect on its effectiveness. Preparation F-11 possesses no mutagenic activity. (tr-auth)

20149 THEORY OF SOMATIC MUTATION IN RELATION TO AGING. EFFECT OF IONIZING IRRADIATION AND SOME ANTIOXIDANTS ON THE LIFE SPAN OF DROSOPHILA MELANOGASTER. Felix Estrada, R. Mexico City; Univ. Nacional Autonoma de Mexico (1972). 133p. (In Spanish).

Thesis.

Experimental data reviewed are not sufficient to support definitively the theory of somatic mutation. However, they do not deny the intervention of somatic mutations as one of the probably most significant causative mechanisms of the syndrome of aging in D. melanogaster. Sublethal doses of fast electrons were applied to imagoes of D. melanogaster and survival curves were derived. Analysis of the curves favors the hypothesis of the acceleration of aging caused by irradiation since the percentage of half survival was independent of the age at which the adults were irradiated. The life expectancy following irradiation was shortened to a greater degree in males than in females, a result that is congruent with the loss or differential cellular inactivation, owing to the haploidy of a fifth part of the genome in the male, which makes possible the expression of recessive lethal or detrimental genes on the X chromosome. With the application of smaller doses of radiation, the life expectancy was increased in some cases. In the female this was attributed to the sterility produced by the treatment. To investigate the genetic relationship with the half lethal dose in four species of Drosophila, imagoes were irradiated by fast electrons within the limits of 8.32 to 91.52 kR. Between D. melanogaster and D. simulans a significant difference in the value of the LD_{50} was not encountered. Both are closely related species of the melanogaster group that have the same chromosome structure and are capable of producing interspecific descendents. The addition of the antioxidants butylhydroxytoluene, butylhydroxyanisole, and propyl gallate, to the culture medium increased significantly the period of half life of some of the groups of adults thus treated. The effect was more notable in males than in females, which suggests a protection against some type of genetic danger induced by free radicals that are generated spontaneously in postmitotic cells. It was concluded that theoretical postulate and experiments support the hypothesis that the changes that lead to aging are essentially genetic in character. (tr-auth)

20150 NEUTRON IRRADIATION AND ITS POSSIBLE APPLICATION FOR INSECT CONTROL. Offori, E. D. (International Atomic Energy Agency, Vienna). pp 233-7 of Radiobiological Applications of Neutron Irradiation. Vienna; International Atomic Energy Agency (1972).

From Meeting on radiobiological applications of neutron irradiation; Vienna, Austria (6 Dec 1971). See STI/PUB-325; CONF-711204.

Research on the application of the sterility principle for insect control or eradication is reviewed with emphasis on neutron irradiation of insects. The applicability of neutrons for insect control is discussed. (auth)

20151 PROPHAGE INDUCTION AND CELL DIVISION IN E. COLI. I. Further Characterization of the Thermosensitive Mutation Tif-1 Whose Expression Mimics the Effect of Uv Irradiation. Castellazzi, M.; George, J.; Buttin, G. (Institut de Biologie Moleculaire, Paris). Mol. Gen. Genet.; 119: No. 2, 139-152(1972).

An apparently single pleiotropic mutation tif-1 causing thermal induction of λ and thermal filamentation is mapped close to recA and is shown to be responsible for the thermosensitive phenotype of of E. coli C600 T44. Expression of the tif-1 mutation mimics the effect of uv irradiation in causing several $recA^+$-dependent events: prophage induction, cell filamentation (both previously observed by Goldthwait and Jacob, 1964, and by Kirby, Jacob and Goldthwait, 1967) and, survival of infecting uv-irradiated bacteriophage λ, and mutagenesis of uv-irradiated λ. Expression of the tif-1 mutation differs from the effect of uv irradiation in two respects: It has no apparent effect on bacterial DNA structure as measured biochemically; or as measured physiologically here by the capacity for conjugal transfer of DNA or by the capacity for causing indirect induction of λ which normally occurs after the introduction of a uv-irradiated sexual factor into a lysogenic F^- recipient (George and Devoret, 1971). It does not increase $recA^+$-dependent recombination between an $F\text{-}lac^+$ episome and the chromosome or between two recombination deficient λ int red phages. These results suggest that the tif^+ gene product participates in a reaction common to the pathway of uv induction and to the pathway of repair of uv-induced lesions in DNA. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 19809, 19816, 19821, 19824, and 20069.

20152 (BNWL-SA-3840) ROUTINE AND EMERGENCY EVALUATIONS OF INTERNAL EXPOSURE AT HANFORD. Held, K. R.; Jech, J. J.; Bramson, P. E. (Battelle Pacific Northwest Labs., Richland, WA). Jul 1971. Contract At(45-1)-1830. 18p. (CONF-710710-14). Dep. NTIS.

From 16th Annual Health Physics Society Meeting; New York, New York, United States of America (USA) (12 Jul 1971).

Methods are described that are used for estimations of the internal radiation dose to personnel following the inhalation of aerosols of transuranium elements. The detection of activity on protective clothing, nasal smears, nose blows, sputum samples, and surfaces of work areas can be used to provide an indication of the severity of a possible inhalation exposure. For exposures involving ^{239}Pu, isotopic composition of Am and α ratios of the aerosol source should be determined by a combination of mass and α spectrometry. Other data used in estimations of inhalation intake include radiometric analysis of samples of feces and urine; measurements of activity on the skin; estimations of aerosol particle size based on microscopic examination of air filters and nasal smears; external counting of activity in the lungs; and the collection of all available data on the duration and other details of the inhalation exposure. (CH)

20153 (ORNL-4811, pp 86-90) ESTIMATES OF ABSORBED FRACTIONS FOR PHOTON EMITTERS WITHIN THE BODY. Snyder, W. S.; Ford, M. R.; Warner, G. G. Sep 1972.

In Health Physics Division annual progress report for period ending July 31, 1972.

The preliminary study reported last year was extended to obtain reliable estimates of specific absorbed fractions for photon emitting radioisotopes within the human body at energies where the corresponding Monte Carlo estimates have a large coefficient of variation. Absorbed fractions computed by the Monte Carlo method for a variety of organs of an anthropomorphic phantom

have been published. The photon source is assumed uniform in 16 different organs, and absorbed fractions φ are estimated in some 22 organs whenever the coefficient of variation for a sample of 30,000 photons is less than 50%. A method is described which is quite general, whose accuracy is not dependent on organ size, and which, for the adult body, appears to be accurate for organs of the trunk to within a factor of 2, being generally within some 20 to 30% of the values reliably estimated by the Monte Carlo calculation. Data on the specific absorbed fraction are plotted for photons of energies 0.03, 0.05, 0.1, 0.5, 1, 1.5, and 4 MeV. (CH)

20154 (ORNL-4811, pp 91-6) ESTIMATES OF DOSE TO INFANTS AND CHILDREN FROM A PHOTON EMITTER IN THE LUNGS. Hilyer, M. J. C.; Snyder, W. S.; Warner, G. G. Sep 1972.

In Health Physics Division annual progress report for period ending July 31, 1972.

When a radioisotope monoenergetic photon source is distributed uniformly in any human organ (called the source organ S), the dose rate to any other organ (called the target organ T) is proportional to the specific absorbed fraction (SAF or Φ). This SAF is simply the fraction of energy emitted, which is absorbed per gram of the target organ. On the basis of the inverse square law, for the same source of photons in the organ of a child and of an adult, the child will receive the greater dose rate. The adult phantom was reduced by scale factors selected separately for the head section, trunk section, and leg section of the adult phantom. All of the organs and tissues within these sections were reduced by the scale factors for that section. Explicit transformation formulas were applied so that these transformations were similitudes. The new phantoms obtained in this way correspond to typical individuals of ages 0, 1, 5, 10, and 15 years. Using this transformation, it was easy to adapt the computer program for the new phantom. Examples are presented of calculations of the radiation dose absorbed from photons of energies ranging from 0.01 to 4.0 MeV when the lungs or the contents of the stomach were the source organ and the target organs were the liver, skeleton, lungs, kidneys, or small intestine plus contents. The results showed that generally the SAF is greater for the younger ages; that, for a given age and for the target organ being different from the source organ, the SAF passes through a maximum which seems to occur at 30 to 50 keV; that when the source and target organs are the same, the SAF generally increases as energy decreases; that the ratio $(SAF)_{x\ age}/(SAF)_{adult}$ seems generally to increase as energy decreases; and that the published values for the absorbed fractions for the adults should not be used for calculating the dose rate for the newborn and children. (CH)

20155 (ORNL-4811, pp 99-101) METABOLIC MODEL FOR MAGNESIUM IN MAN AND AN ESTIMATE OF DOSE TO BONE AND SOFT TISSUE RESULTING FROM A SINGLE INTRAVENOUS INJECTION OF ^{28}Mg. Bernard, S. R. Sep 1972.

In Health Physics Division annual progress report for period ending July 31, 1972.

The metabolic model for magnesium in man developed by Avioli and Berman, based on measurements of blood, urine, and feces, was modified for use in estimations of the radiation dose absorbed by bone and soft tissue following a single intravenous injection of ^{28}Mg. Equations were developed for retention organs, tissues, and total body. Computer calculations of the absorbed radiation dose, based on the energy release during the decay of ^{28}Mg, were carried out. (CH)

20156 (ORNL-4811, pp 102-7) METHOD OF INTERPRETING EXCRETION DATA WHICH ALLOWS FOR STATISTICAL FLUCTUATION OF THE DATA. Snyder, W. S. Sep 1972.

In Health Physics Division annual progress report for period ending July 31, 1972.

Personnel monitoring of ^{239}Pu and certain other α emitters of similar characteristics pose problems. Methods using in vivo counting of the chest and excretion data are reviewed. It is pointed out that the only Pu excretion data on humans under controlled experimental conditions was obtained in 1945 and 1946 when 15 terminal cancer patients were given Pu and urinary and fecal excretion data collected until death. There are only two cases of personnel exposures during a period of five and eleven years where both excretion data and autopsy data are available. In neither case did the death of the subject result from exposure to Pu. An attempt was made to develop a computer technique for estimation of the whole-body dose on the basis of excretion data that would allow for fluctuations. When the computer method was applied to the excretion data of these two employees, the predictions of the systemic body burden agreed well with the estimates based on autopsy data. (CH)

20157 (ORO-3734-6) EVALUATION OF THE ABSORBED DOSE FROM THE DIAGNOSTIC USE OF RADIOPHARMACEUTICALS. Annual Report. Amtey, S. R. (Miami Univ., Fla. Div. of Nuclear Medicine). 5 Oct 1972. Contract AT(40-1)-3734. 44p. Dep. NTIS.

Efforts were directed towards exploring methods by which a volume distribution in the patient of radiopharmaceuticals could be deduced. The concept of volume source response function was developed and its use on the rectilinear scanner image was studied. This concept was further developed and used on scintillation camara images. Radionuclide tomography was also studied as a method of obtaining volume distribution in the patient of the diagnostic radiopharmaceutical. Software was developed to do the MIRD calculations of the absorbed dose. Some experiments were performed to measure the biological turnover data on ^{75}Se-L-Selenomethionine. A brief summary of results is given. A list of material published or submitted for publication is included. (CH)

20158 ACCUMULATION OF ^{137}Cs IN FINNISH LAPPS. Rahola, T.; Miettinen, J. K. (Univ. of Helsinki). Arch. Environ. Health; 26: No. 2, 67-69(Feb 1973).

Data are presented on the internal radiation dose to Finnish Lapps in 1962 through March of 1971 in relation to ingestion of fallout ^{137}Cs. The effects of age, diet, sex, occupation, season, and geographical location on ^{137}Cs uptake are discussed. It is pointed out that ^{137}Cs may enter the diet of the Lapps through lichen-reindeer-meat, water-fish-food, or vegetation-cattle-milk food chains. A group of reindeer herders had an internal dose estimated at about 60 mrad during 1970, the highest dose found. Sources of external irradiation, both natural background and artificial sources, added a dose rate of approximately 20 mrad/yr for this population group. (CH)

20159 ^{111}In-CHLORIDE: A NEW AGENT FOR BONE MARROW IMAGING. Lilien, D. L.; Berger, H. G.; Anderson, D. P.; Bennett, L. R. (Univ. of California, Los Angeles). J. Nucl. Med.; 14: No. 3, 184-186(Mar 1973).

Studies comparing the in vitro disposition of transferrin-bound ^{111}In and ^{59}Fe have demonstrated that the characteristics of their transport into reticulocytes are very similar, if not identical. Clinical studies have further demonstrated the distribution of ^{111}In in erythroid marrow and the sensitivity of this process to irradiation in doses which did not affect radiocolloid distribution. Considering the shortcomings of radiocolloid and radioiron agents and the ideal physical and imaging characteristics of ^{111}In, the bone marrow imaging agent of choice would appear to be ^{111}In-chloride. (auth)

20160 MEASUREMENT OF RADIOACTIVITY IN BODY ORGANS. Report on a Scientific Meeting of the International Atomic Energy Agency. Nucl.-Med.; 11: No. 3, 203-225(15 Nov 1972). (In German).

The techniques available for the measurement of radioactivity in body organs and the main problems which they entail are discussed. Measurements techniques based on the use of fixed detector systems, techniques based on whole-body radioactivity measurements, techniques based on the analysis of profile scanning data, and techniques based on the analysis of scintigraphic data are considered. The present status of each technique is reviewed, its particular advantages and disadvantages are indicated and its main applications listed. Consideration is also given to the relative sensitivities of different techniques. (auth)

20161 RADIATION DOSES TO PATIENTS FROM RADIONUCLIDE INVESTIGATIONS. A survey carried out in New Zealand in 1967. McEwan, A. C. (National Radiation Lab., Christchurch, N. Z.). pp 145-160 of Frontiers of Nuclear Medicine. Horst, W. (ed.). New York; Springer-Verlag (1971).

Data were collected on all in vivo radionuclide tests and treatments carried out in New Zealand over a 3 month period in 1966. For each type of investigation an assessment was made of the radiation doses received by organs of increased uptake and by the gonads. From the statistical data of the numbers and types of investigations and treatments and the calculated gonad doses, an annual genetic dose to the population of 0.062 mrad per person was determined, of which only 0.015 mrad arose from the use of radionuclides in diagnosis. (auth)

20162 SIGNIFICANCE OF THE TIME FACTOR IN THE ASSESSMENT OF RADIATION DOSES IN NUCLEAR MEDICINE. Pfannenstiel, P. (Univ., Freiburg i.B.). pp 171-183 of Frontiers of Nuclear Medicine. Horst, W. (ed.). New York; Springer-Verlag (1971). (In German).

From assessments of radiation doses after incorporation of radionuclides, internal radiation at low dose rates appears to be significantly less effective than fractionated external irradiation at high doses of equal physical magnitude. The difference is related to the "time factor", i.e. there is more opportunity for tissue recovery during the longer irradiation period. An evaluation of 53

patients treated with ^{131}I for toxic and nontoxic goiter, thyroid cancer, and malignant lymphoma revealed that thyrotoxic patients received some three to six times greater whole-body irradiation doses than patients with nontoxic goiters or thyroid cancer. When the thyroid is overactive, the greater portion of the dosage to the blood comes from the slow-release protein-bound ^{131}I phase. When an initial high dose is given in thyroid cancer therapy, an increase of reticulocytes has definitely been established. In contrast, patients receiving a low whole-body ^{131}I irradiation delivered over a longer period have shown no hematological response. In accordance with these observations, the author emphasizes the important biological aspects for dosimetry in diagnostic nuclear medicine procedures. (auth)

Animals

Refer also to abstract 20172.

20163 SOME EFFECTS OF MAMMALIAN DEVELOPMENT OF CONTINUOUS IRRADIATION IN UTERO WITH TRITIATED WATER. Cahill, D. F. Rochester, NY; Univ. of Rochester (1970). 134p. University Microfilms Order No. 71-14,035.

Thesis (Ph. D.).

Nuclear reactor-effluent and fuel reprocessing waste streams containing elevated levels of tritium activity are confluent with rivers providing part or all of the residential water supplies in some areas. Most of the tritium release is in the form of tritiated water (HTO), which is rapidly and uniformly distributed in body fluids. Since the body water of a pregnant female is in equilibrium with the HTO activity prevailing in the local environment, the embryo and fetus, the most radiosensitive phases of life, develop in an aqueous environment, which provides continuous irradiation of its total body. As an adjunct the embryo and fetus incorporate tritium as a substitute for hydrogen into their organs and tissues during development. To investigate the consequences of continuous, in utero exposure to HTO, groups of 12 to 17 Sprague–Dawley rats were maintained at body water levels of 0, 1, 10, 20, 50, 75, and 100 μCi/ml HTO through pregnancy. The initial maternal body burdens were established on the day of positive sperm determination by intraperitoneal injection of high specific activity HTO. Body water HTO levels were then maintained at a constant level during pregnancy by providing HTO in drinking water supplies. These HTO activities provided irradiation at 0.3 to 30 rads/day to the embryo and fetus during development. Regardless of the exposure level all progeny were grossly normal with respect to external and internal morphology. Statistically significant litter size reduction associated with increased resorption occurred only at the highest dose level. Significant decreases in the absolute weights of a number of irradiated term fetus organs were closely proportional to dose. The relative radiosensitivities of term fetal organs to continuous irradiation were: gonads > brain > spleen > thymus > kidney > heart. With the exception of a significant increase in liver weight at 1 μCi/ml there was no apparent effect on the lungs and liver. Comparison of the results of these HTO irradiations with the effects of continuous, external gamma irradiation during pregnancy in the rat showed that an RBE of 1.7 was necessary to equate the results. Continuous exposure to 1 μCi/ml HTO during pregnancy in the rat was found to be consistent with the production of offspring in which the only deviations from controls noted were an increase in length and slight hyperplasia of the liver and heart. Subject to the limitations inherent in assuming an equivalence of the rat and human fetus, 1 μCi/ml HTO is 200 times greater than the maximum continuous exposure recommended by the ICRP for members of the public living in the vicinity of a controlled (radiation) area. (Diss. Abstr. Int., B)

20164 RADIOECOLOGICAL STUDIES IN SOIL ZOOLOGY. Gilyarov, M. S.; Krivolutskii, D. A. Zool. Zh.; 50: No. 3, 329-342(1971). (In Russian).

A birch forest was contaminated with 1.8 to 3.4 $\mu Ci/m^2$ ^{90}Sr and populations of small animals were used as bioindicators of the contamination. The population of saprophytes was reduced by 70 fold due to their low motility and topsoil habitat; the phytophyte population was reduced by one half; and the predator population was reduced by one third. Flying insects were unsuitable as bioindicators unless the field could be shielded from new migration. The number of species of microarthropods declined four-fold although the total number did not diminish. (Euratom)

Microorganisms

20165 BIOLOGICAL EFFECTS OF THE DECAY OF RADIOPHOSPHORUS INCORPORATED INTO MICROORGANISMS. Gracheva, L. M.; Korolev, V. G. (Ioffe Inst. of Physics and Tech., Leningrad). Usp. Sovrem. Biol.; 72: No. 1, 143-58(1971). (In Russian).

A review of the literature is presented, in connection with the lethal, mutagenic, and recombinogenic effects of ^{32}P when introduced into various microorganisms: phages, bacteria, and fungi. Data from the literature are reviewed on the restoration of monocatenulate and bicatenulate ruptures when caused by the decay of incorporated ^{32}P. An analysis is made of the biological consequences of the decay of ^{32}P, and allowing for chemical results of such decay, the potential damage to DNA is assayed. (tr-auth)

Nuclide Kinetics and Toxicology

Man

Refer also to abstract 20160.

20166 (CEA-CONF-2137) INTESTINAL ABSORPTION OF LEAD. Karhausen, L. R. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1972. 16p. (CONF-720467-1). Dep. NTIS (U. S. Sales Only).

From Conference on the Metabolism of Lead in the Human Body; Luxembourg, (25 Apr 1972).

Studies were conducted on intake and output of lead in France, Mexico, Germany, and the United States and results are tabulated. Studies on inhalation of ^{212}Pb showed that the level of ^{212}Pb in the blood parallels the atmospheric concentrations in the area where the exposed population lives. Results of intake studies showed that oral intake amounts to approximately 0.44 mg in adults and 0.15 mg in children. Absorption in the intestine depends on chemical form, dietary Ca, vitamin D intake, diet composition, gastric acidity, and other factors. Inhaled lead contributes a significant part to lead intake. It varies with the atmospheric concentration, the size of particles, and physiological factors. (HLW)

20167 WHOLE-BODY RETENTION AND EXCRETION OF MAGNESIUM IN HUMANS. I. Biological half-life in normal and selected disease states. II. Radiation dosimetry. Roessler, G. M. S. Gainesville, FL; Univ. of Florida (1972). 186p. University Microfilms Order No. 73 965.

Thesis (Ph. D.).

Thirty-one whole-body retention and excretion measurements were made on 13 normal subjects and 12 patients with selected disease conditions to determine as accurately as possible the biological half-lives from a single intravenous administration of ^{28}Mg in the form of $MgCl_2$. Calculation of radiation dose based on the determined half-lives was an important aspect of the research since the experimental use of ^{28}Mg is increasing rapidly and no dose estimates have been established. The feasibility of this measurement technique for studying abnormalities in disease conditions was also explored. A high-specific-activity (200-300 microcuries per milligram magnesium) preparation of the radioactive isotope ^{28}Mg (21.3-hr physical half-life) was used in conjunction with the sensitive 4-pi liquid scintillation whole-body counting technique for retention measurements. A NaI(Tl) crystal whole-body counter was employed to measure localization of the magnesium in the body and appropriate low-level counting systems were used for measurement of the isotope in excreta. Whole-body retention data from the determinations on normal subjects were fit to a sum of two exponentials model. The coefficients of the resultant equation are 8.5 and 91.5 and represent the quantities in per cent involved in the turnover of the two compartments. Biological half-lives of 5.4 ± 2.2 hrs for the first compartment and 540 ± 35 hrs for the second compartment were calculated from the rate constants in the exponents of the fitted equation. The radiation dose from this single administration of ^{28}Mg was calculated to be 2.0 mrad/microcurie. In the normal subjects, excretion measurements on the average accounted for the amount of the ^{28}Mg not retained in the body. Cumulative urinary excretion averaged 3% per day while fecal excretion was approximately 0.5% per day. Whole-body retention values for amyotrophic lateral sclerosis and sub-total gastrectomy patients were significantly lower than normal, while several subjects, one of whom was known to have been on diuretics, had higher than normal retention of the isotope. Repaired gastrectomy patients had retention patterns within the normal range. In the majority of the patients studied, the abnormal retention of ^{28}Mg was accounted for by amounts in the excreta. However, in several patients, excretion did not account for the total amount of the isotope not retained in the body, resulting in a deficit in the total-measured ^{28}Mg. Localization of the isotope in the body as measured by NaI(Tl) crystal whole-body counting showed consistent patterns between results of the normal subjects. An atypical build-up of the isotope was found in the abdominal region of the amyotrophic lateral sclerosis

patient who previously exhibited an apparent precipitous whole-body loss of ^{28}Mg. Based on published investigations to date, it is concluded that this turnover study is currently the most accurate. The use of a true tracer dose of 10 microcuries or less of high specific activity ^{28}Mg and the sensitive whole-body counting system allowed administration of a dose that would not upset the physicochemical balance of the body. Also, this procedure permitted measurements up to six times longer than previously reported studies. The amount of ^{28}Mg to be administered in future investigations with this isotope should be guided by the 2.0 mrad/microcurie dose calculated from the data obtained in this study. Based on the consistent, significantly abnormal retention and excretion patterns shown by certain disease-state measurements in this study, it is concluded that this turnover procedure could serve as a valuable adjunct to other diagnostic techniques. (Diss. Abstr. Int., B)

20168 IN VITRO STUDIES OF ^{99m}Tc-PERTECHNETATE BINDING BY HUMAN SERUM AND TISSUES. Hays, M. T.; Green, F. A. (State Univ. of New York, Buffalo). J. Nucl. Med.; 14: No. 3, 149-158(Mar 1973).

Of clinical interest because of its widespread use in nuclear medicine, $^{99m}TcO_4^-$ was found to bind to human serum proteins in vitro and to a variety of human tissue homogenates. At 37°C and pH 7.4, approximately 80% (equilibrium dialysis) or 65% (ultrafiltration) of $^{99m}TcO_4^-$ was found to be bound to serum proteins. Binding was increased in the cold and by an acid shift in pH. It was decreased in tissues from debilitated patients and by a variety of pharmaceuticals. For equimolar concentrations, relative effectiveness in blocking serum $^{99m}TcO_4^-$ binding in vitro was: sodium salicylate > $KClO_4$ > acetylsalicylic acid > propylthiouracil > prednisone > KI. By a variety of techniques, albumin was shown to be the primary if not the only serum $^{99m}TcO_4^-$ binding protein. Serum binding is weak, as additionally evidenced by complete release on electrophoresis or with prolonged dialysis in an open system. After equilibration with insoluble tissue fractions, $^{99m}TcO_4^-$ binding per gram was: abnormal synovium = normal synovium > liver > red blood cell membrane > brain. After equilibrium dialysis with minced whole tissues, "equilibration" binding per gram of wet weight was: liver > serum > thyroid > kidney > muscle > skin > abnormal synovium > brain > normal synovium. Kinetic studies of these tissues suggested that $^{99m}TcO_4^-$ binding was completely reversible only in serum and the synovial specimens with retarded efflux particularly from the liver and thyroid specimens. (auth)

Animals

20169 (AECL-4361) FEEDING RATE OF DAPHNIA MAGNA STRAUS IN DIFFERENT CONCENTRATIONS OF THE TERPHENYL COOLANT: HB-40. McMahon, J. W. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs). Jan 1973. 12p. Dep. NTIS (U. S. Sales Only). AECL $0.50.

The feeding rate of Daphnia magna was measured with 32p-labelled yeast cells in suspensions of a reactor coolant terphenyl mixture HB-40 and its irradiation-produced polymers. As coolant concentration increased over the range 0.1 to 10.0 mg/l, feeding rate rapidly decreased. In all cases feeding rates were reduced 50% below the normal when coolant concentrations in lake water exceeded 0.5 mg/l. Feeding rate was also influenced by the percentage of polymers in suspension. The use of physiological factors as indicators for determining sublethal effects is discussed. (auth)

20170 KINETICS OF ^{67}Ga COMPOUNDS IN BRAIN SARCOMAS AND KIDNEYS OF MICE. Konikowski, T.; Glenn, H. J.; Haynie, T. P. (Univ. of Texas, Houston). J. Nucl. Med.; 14: No. 3, 164-171(Mar 1973).

Studies of experimental tumor and tissue localization and renal clearance in mice of intravenously injected ^{67}Ga–chloride, citrate, lactate, and iron–DTPA reveal significant differences between the ^{67}Ga–iron–DTPA and the other compounds. The latter three compounds show slower renal clearance and higher tumor nuclide content. The tumor-to-brain ratios remain good during the time of study. The tumor-to-blood and tumor-to-muscle ratios slowly increase with time. There is significant and prolonged skin uptake by all four compounds. Consequently, the tumor-to-skin radios do not improve with time. Subtle differences between the pharmacodynamics of ^{67}Ga–lactate and ^{67}Ga–chloride and that of ^{67}Ga–citrate and the decreased toxicity of lactate suggest that the tumor uptake of ^{67}Ga–lactate and chloride should be given more study. (auth)

20171 EFFECT OF DIETHYLENETRIAMINEPENTAACETATE ON THE ^{241}Am CONTENT OF DIFFERENT BONES OF RATS. Seidel, A.; Volf, V. (Kernforschungszentrum, Karlsruhe, Ger.). Naturwissenschaften; 59: No. 12, 652(Dec 1972). (In German).

Rats were injected intravenously with ^{241}Am-citrate, and after 90 min or 4 days were given injections of Ca-DTPA or Zn-DTPA. Seven days later the bones were removed and the alpha activity was determined. A table is presented to show results for epiphyses and diaphyses of the femur, parietal os, mandibles, teeth, and ribs. It was concluded that the ^{241}Am activity of the femur is a good illustration of the relations in the entire skeleton. The effectiveness of both chelates in individual bones exhibited only insignificant differences. (HLW)

20172 THEORETICAL ANALYSIS OF THE KINETICS OF DISTRIBUTION AND EXCRETION OF RADIUM ISOTOPES BY MEANS OF A COMPARTMENT MODEL. Kaul, A. (Freie Univ., Berlin). pp 104-115 of Frontiers of Nuclear Medicine. Horst, W. (ed.). New York; Springer-Verlag (1971). (In German)

The contrast medium Thorotrast (^{232}Th) was often used in the period 1930 to 1945; data obtained from the fairly large number of surviving patients enable radiation dose rate and somatic radiation effects to be correlated but give no information about radiation dosage over a period of time. To enable the cumulative dose to be calculated, experiments over 530 days were carried out on adult male rabbits that had 2 cm^3 of contrast medium injected into the ear vein. To establish the theoretical basis of the daily excretion of the disintegration products, ^{228}Ra and ^{224}Ra, a three-compartment model was constructed: skeleton excluding bone marrow (K); reticulo-endothelial system RES (R); and the remaining intra and extra-cellular spaces (G). By comparing the curves calculated by means of the model with the measured daily ^{228}Ra excretion, it is possible to evaluate the total skeletal retention and excretion from the body of radium in ionic form. (auth)

20173 VISUALIZATION OF RADIOACTIVITY IN THE DOG FOLLOWING ADMINISTRATION OF VARIOUS ^{11}C-CARBOXYLATES. Winchell, H. S.; Winstead, M. B. (Univ. of California, Berkeley). Contract W-7405-Eng-48. pp 161-170 of Frontiers of Nuclear Medicine. Horst, W. (ed.). New York; Springer-Verlag (1971).

Low radiation dose, high resolution tomographic positron scintiphotography and potential for isologous labeling of a large variety of organic compounds attendant to its use makes ^{11}C a potentially extremely important radioisotope in nuclear medicine. Work with thirteen ^{11}C-carboxylates demonstrates rapid renal concentration and excretion of benzoate, p-chlorobenzoate, and 2-thiophenecarboxylate suggesting their usefulness in morphological as well as functional studies of this organ. Hepatic as well as renal concentration of phenylacetate, 3,4-dimethoxybenzoate, o-hydroxybenzoate (salicylate), and cyclohexanecarboxylate suggests their use in morphological and functional studies of both these organs. (The latter two compounds appear to show some concentration in the heart as well.) In addition to accumulation and excretion of 1-naphthoate and pentanoate in the liver and kidneys, these compounds localized in the gall bladder suggesting their use in morphological and functional studies of this organ. The apparent exclusion of all of these compounds from the brain and their lack of concentration in salivary glands and nasal sinuses suggest their possible usefulness in visualization of brain lesions. The diffuse abdominal distribution of butyrate and octanoate suggest accumulation in mesenteric and omental fat, and if such is the case further studies with these materials might be useful in visualizing the kinetics of fatty acid deposition. (auth)

Plants

Refer also to abstract 19836.

20174 (FOA-4-4525-A-3) STUDIES ON PLANT ACCUMULATION OF FISSION PRODUCTS UNDER SWEDISH CONDITIONS. XIII. Entry of ^{90}Sr and ^{137}Cs Into the Herbage of Contrasting Types of Pasture. Haak, E.; Eriksson, A.; Karlstroem, F. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Jan 1973. 46p. Dep. NTIS (U. S. Sales Only).

The entry of ^{90}Sr and ^{137}Cs from simulated fallout single depositions into the herbage of pasture was studied in a long-term field experiment for six years at two different sites. One field was located on permanent natural pasture on an acid sandy soil and the other on a pasture of long duration on a neutral clay soil. At both these fields fertilizer experiments had been running for 11 years in advance. The distribution of activity in the soil profile was studied at the end of the experimental period. The entry of ^{90}Sr into herbage was greater than the entry of ^{137}Cs at both sites already in the first cut after contamination. It declined more for ^{137}Cs than for ^{90}Sr in the successive cuts this year, and relatively more on the grazing pasture than on the permanent pasture, where

it decreased from year to year for both nuclides. The mean ^{90}Sr/Ca-ratio was about four times higher on the permanent pasture than on the grazing pasture, while the mean content of ^{137}Cs per unit dry matter was about ten times higher on the former than on the latter. (auth) (Sweden)

20175 ACCUMULATION OF ^{137}Cs BY CRYPTOGAMS IN A LIRIODENDRON TULIPIFERA FOREST. Hoffman, G. R. (Univ. of South Dakota, Vermillion). Bot. Gaz. (Chicago); 133: No. 2, 107-119(Jun 1972).

The accumulation of ^{137}Cs in cryptogamic components of a tagged Liriodendron tulipifera L. forest at Oak Ridge, Tennessee, was determined in 1968. Within a 500 m^2 study plot, tagged in 1962 with 467 mc ^{137}Cs, terrestrial bryophytes had accumulated 1.16 mc, tree-base moses 0.39 mc, epiphytic lichens on main stems 2.52 mc, and canopy lichens 0.16 mc. The total, 4.23 mc, is less than 1% of the total ^{137}Cs introduced in 1962, but the ^{137}Cs content of certain of the cryptogams was greater, on a unit dry weight basis, than tree foliage which represents the source of the radionuclide to the cryptograms. Terrestrial bryophytes receive all, or most, of their ^{137}Cs directly from raindrip from the overhead tree canopies, and epiphytes receive their ^{137}Cs from stemflow. Experimentally determined uptake efficiencies of ^{137}Cs were 92% for the terrestrial bryophyte mat (living plus dead), and 67% for the vertically oriented epiphytic lichens, most of which were foliose. Tree-base mosses plus their absorbent bark substrate absorbed 90% of the ^{137}Cs supply. Loss rates of ^{137}Cs by cryptogams were also determined experimentally. The interpretation of "uptake" (or "input") influences the calculation of loss rates. If uptake is considered to be the total supply of ^{137}Cs which reaches the cryptogams, loss rates will necessarily be higher than if uptake is that amount of ^{137}Cs which reaches the cryptogams multiplied by an uptake fraction; the uptake fraction is determined experimentally. Elimination half-times are discussed in light of loss rate calculations. A computer simulation of ^{137}Cs accumulation by cryptogams from 1962 to 1969 was done to provide visual form to the process of accumulation by the cryptogamic components of the Liriodendron forest. (auth)

20176 UPTAKE AND TRANSLOCATION OF ^{85}Sr, ^{59}Fe, ^{185}W, AND ^{134}Cs BY BANANA PLANTS AND COCONUT PLANTS FOLLOWING FOLIAR APPLICATION. Thomasson, W. N. Gainesville, FL; Univ. of Florida (1972). 154p. University Microfilms Order No. 73-971.

Thesis.

Bananas or plantains (cooking bananas) and coconuts comprise a significant part of the diets of the people residing in the areas of Panama and Colombia under consideration for a sea-level interoceanic canal. A mixed radiotracer experiment on a banana plant and a coconut palm was designed as part of the evaluation of the radiological effects of a Plowshare project, such as the one proposed for construction of a sea-level interoceanic canal. A second replicated field study was conducted to measure the rate of accumulation of ^{134}Cs in bananas following foliar application of the isotope. Carrier-free, soluble tracers (^{85}Sr, ^{59}Fe, ^{185}W, and ^{134}Cs) were applied to a portion of the foliage of both banana and coconut plants. Following foliar absorption, the translocation and distribution of these tracers within the plants were studied with special emphasis on the fruit. It was found that only ^{134}Cs accumulated in the banana pulp and the coconut fruit (meat and water) following this type of foliar application. However, some of each radiotracer was detected in plant parts other than the treated foliage. The ground was covered with plastic sheeting, which in turn was covered with peat moss. A plastic bottle with a sponge applicator was used to treat the foliage. However, detectable levels of radioactivity were found in the banana plants, coconut plants, and weeds and grasses adjacent to the treated plants. Cesium-134 was translocated to adjacent plants in general, while ^{59}Fe, ^{85}Sr, and ^{185}W were detected in the fruit of adjacent banana plants and second growth grasses and weeds near the base of the palm tree. The translocation resulted in slight accumulation of ^{59}Fe and ^{185}W in the peels of the neighboring bananas in particular. This contamination was attributed to direct root-to-root translocation. Cesium-134 accumulation by bananas following foliar absorption was characterized by a first order kinetics function of the type $C = C_e(1 - e^{-kt})$. The rate constant (k) was determined to be -0.133 per day based on the least squares best fit of the data. The replicated experiment provided individual rate constants of -0.123, -0.158, and -0.122 per day for the three test plants. The equilibrium concentration values (C_e) expressed as a percentage of the concentration applied to the foliage were 0.40 percent, 0.80 percent, and 0.12 percent. The C_e varied as a function of the maturity of the fruit and the atmospheric conditions during and following tracer application. However, the rate constants were independent of the atmospheric conditions. As a result of these field experiments, it is evident that even with heavy rain during and following the period of fallout deposition radiologically significant amounts of radioactivity will be absorbed and retained by the foliage of banana and coconut plants. A model was developed to predict the yearly whole body dose to an individual who eats contaminated bananas. This model evaluates the dose as a function of (1) the concentration ($\mu Ci/m^2$) of fallout on the plant foliage; (2) the rate of consumption of contaminated bananas; and (3) the duration of consumption of the bananas. (Diss. Abstr. Int., B)

20177 RADIOACTIVE STRONTIUM IN THE SOIL–PLANT COVER OF PASTURES OF THE EASTERN PAMIRS. Tyuryukanova, E. B.; Konova, N. I.; Saboiev, S. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Ekologiya; No. 1, 45-48 (1971). (In Russian).

Soil and plant samples were collected from different regions of the eastern Pamirs at altitudes of 3500 to 4800 m. Radiochemical analyses of HCl extracts of soils and plants were made for ^{90}Sr content. The soil content of ^{90}Sr was in the range of 12 to 70 $\mu Ci/m$. The ^{90}Sr content of the soil was related to disintegration, humus content, and stoniness. The ^{90}Sr content of plants was 1000 to 3500 $\mu Ci/kg$ depending on altitude. Some plants accumulated ^{90}Sr primarily in their above-ground parts, while other species accumulated ^{90}Sr mostly in the roots. The ^{90}Sr accumulation was also related to the rainfall in the area. (Euratom)

20178 ACCUMULATION OF RADIUM AND CALCIUM IN PLANTS AS INFLUENCED BY FERTILIZERS. Ananyan, V. L.; Avetisyan, A. Sh. Soobshch. Inst. Agrokhim. Probl. Gidroponiki, Akad. Nauk Arm. SSR; No. 11, 36-41(1971). (In Russian).

The experiments were carried out in field conditions, both in subalpine meadows and field-vegetation pots on brown soils with lucerne. In the NP and NPK varieties, a high yield of hay was obtained in the meadows. The effect of fertilizers on lucerne is weak. In the subalpine plants (hay) the content of radium in relation to the yield of lucerne is high. When yield of hay is high, there takes place a relative decrease of the contents of radium and Ca. In the variants of NP and NPK the content of radium seems to be increasing slightly. (auth)

20179 UPTAKE OF K AND ^{137}Cs BY ALPINE AND SUBALPINE PLANTS AS INFLUENCED BY FERTILIZERS. Ananyan, V. L.; Mnatsakanyan, B. G. Soobshch. Inst. Agrokhim. Probl. Gidroponiki, Akad. Nauk Arm. SSR; No. 11, 42-60(1971). (In Russian).

The results of the investigations carried out on the meadows of Mt. Aragadz and Gegham mountain ridge zone are discussed. In the experiments of small-size field beds the effect of fertilizers (N, P, K) and liming ($CaCO_3$) on the yield and the accumulation and relation of potassium and ^{137}Cs in the plants (hay) was investigated. The accumulation of ^{137}Cs in plants was contradictory in relation to their yield. In the NP and NPK varieties, of which a high yield was obtained, the content of ^{137}Cs diminished. Interdependence between the accumulation of potassium and yield of plants was not observed. The antagonism of potassium was weak, especially in the alpine zone. Liming of soils (without fertilization) showed a positive effect in the alpine zone while in the sub-alpine zone the uptake of ^{137}Cs by plants increased. (auth)

20180 EFFECT OF FERTILIZERS ON THE ACCUMULATION OF Ca AND RADIOSTRONTIUM IN THE ALPINE AND SUBALPINE MEADOW PLANTS. Ananyan, V. L.; Sarkisyan, G. S. Soobshch. Inst. Agrokhim. Probl. Gidroponiki, Akad. Nauk Arm. SSR; No. 11, 61-73(1971). (In Russian).

Experiments of many years (1962 to 67) were carried out to study the effect of fertilizers and lime on the accumulation of Ca and ^{90}Sr and their ratios in alpine (Mt Aragadz) and subalpine (Mt Aragadz and Gegham mountain ridge) meadow plants growing in beds with sizes of 1.56 to 2.8 cm with up to 4 to 6 repetitions. Of the various experimented fertilizers, (N, PK, NP, NK, NPK) from the point of view of plant productivity and the decrease of specific content of ^{90}Sr, NK and NP are considered to be promising in the alpine and subalpine zones. Results obtained from NPK are contradictory. Liming together with mineral fertilizers show a positive effect in the alpine zone. Liming helps the ratio of ^{90}Sr/Ca in the plants to be diminished. (auth)

New Tracer Techniques

Refer also to abstracts 19523, 19737, 19742, 19752, 19753, 19845, 19868, 20076, 20140, 20168, 20173, and 20174.

20181 (STI/PUB-332) RADIOTRACER STUDIES OF CHEMICAL RESIDUES IN FOOD AND AGRICULTURE. Proceedings of a Combined Panel and Research Coordination Meeting, Vienna,

25–29 October 1971. (International Atomic Energy Agency, Vienna (Austria)). 1972. 172p. (CONF-711069). IAEA $6.00.

Separate abstracts were prepared for 14 of the 20 communications presented in these proceedings. One paper on the fate of certain pesticides under biotic and abiotic conditions appeared in volume 25 of NSA as abstract 51958. The other five papers discuss the uptake of mercury by plants, mercury as an aquatic pollutant, the significance of mercury in the environment, hydrogen phosphine residues in cereals, and the recovery of malathion from aged wheat grain. (ERB)

For abstracts of individual papers see: 19450, 19451, 19523, 19845, and 20184–20193.

20182 EVALUATION OF A DUAL-ISOTOPE METHOD FOR THE MEASUREMENT OF VITAMIN B_{12} ABSORPTION. Briedis, D.; McIntyre, P. A.; Judisch, J.; Wagner, H. N. Jr. (Johns Hopkins Medical Institutions, Baltimore). J. Nucl. Med.; 14: No. 3, 135-141(Mar 1973).

The diagnosis of pernicious anemia (PA) by radioisotope tracer techniques depends on the demonstration of malabsorption of radioactive vitamin B_{12}, which is improved by intrinsic factor (IF). The present study was undertaken to evaluate further the dual-isotope method for the diagnosis of PA. Cobalt-58-B_{12} was given in the free form and ^{57}Co-B_{12} bound to normal human gastric juice (NHGJ). Patients with PA showed significant difference between urinary excretion of the two isotopes; controls did not. PA patients receiving the dual isotope test had significantly higher urinary excretion of B_{12} unaccompanied by IF and lower excretion of B_{12} accompanied by IF than those who received the IF on a different date, probably due to some exchange of the two isotopic forms of B_{12} on IF. PA patients who were retested with ^{57}Co-B_{12} with NHGJ 2 hr after the ^{58}Co-B_{12} showed increase in the difference between the urine excretions of ^{57}Co and ^{58}Co. Plasma level measurement resulted in an overlap of 40% of the PA group with the control group. (auth)

20183 IMPROVED XENON IMAGES WITH ^{127}Xe. Hoffer, P. B.; Harper, P. V.; Beck, R. N.; Stark, V.; Krizek, H.; Lembares, N. (Univ. of Chicago). J. Nucl. Med.; 14: No. 3, 172-174(Mar 1973).

The use of a new xenon isotope, ^{127}Xe, was investigated for imaging studies of brain and lungs. Xenon-127 should be superior to ^{133}Xe because of its higher photon yield per millicurie, better photon energy for imaging with the Anger camera, lower radiation dose to the patient per useful photon detected, and longer shelf-life. As expected, lung and brain images produced with ^{127}Xe appear superior to those produced with equal activities of ^{133}Xe. At present, ^{127}Xe is not genrally available, but its production in large quantities is planned in the near future. (auth)

20184 RECENT RESULTS OF INVESTIGATIONS IN ENVIRONMENTAL CHEMISTRY. Korte, F. (Institut fuer Oekologische Chemie, Schloss Birlinghoven, Ger.). pp 3-14 of Radiotracer Studies of Chemical Residues in Food and Agriculture. Vienna; International Atomic Energy Agency (1972).

From Radiotracer Studies of Chemical Residues in Food and Agriculture Meeting; Vienna, Austria (25 Oct 1971). See STI/PUB–332; CONF-711069–.

A definition of environmental chemicals (bioactive substances) is suggested and studies necessary to evaluate the risks involved in the use of industrial chemicals are outlined. Using the example of chlorinated pesticides some results of radioisotope tracer studies on their fate in the environment are given including metabolism in mammals, microorganisms, plants, and insects, and the conversion under atmospheric conditions on uv irradiation. These studies were carried out aiming to identify the true final conversion products. (auth)

20185 RADIOISOTOPES APPLIED TO ENVIRONMENTAL TOXICITY RESEARCH WITH MICROBES. Kokke, R. (Delft Univ. of Tech., The Netherlands). pp 15-23 of Radiotracer Studies of Chemical Residues in Food and Agriculture. Vienna; International Atomic Energy Agency (1972).

From Radiotracer Studies of Chemical Residues in Food and Agriculture Meeting; Vienna, Austria (25 Oct 1971). See STI/PUB–332; CONF-711069-.

Microbial colonies from soil or waste water streaks grown on nutrient agar with labeled pesticides or heavy elements (micropollutants) are subjected to autoradiography. Microbes that have accumulated the labeled chemicals, thus detected, may be isolated. Autoradiography is also used to screen collected cultures for micropollutant-accumulating strains. The microbes are grown on nutrient agar with a radioactively labeled chemical. Autoradiography combined with the stripping film techniques reveals radioactivity in single cells or in crystals. Autoradiography with the electron microscope localizes the radionuclide in the cells. These techniques permit studies of the effects of the microbes on their microenvironment and effects of the environment on the microbes. (auth)

20186 METABOLISM OF ORGANOPHOSPHORUS INSECTICIDES IN PLANTS. Bull, D. L. (Agricultural Research Service, USDA, College Station, TX). pp 25-33 of Radiotracer Studies of Chemical Residues in Food and Agriculture. Vienna; International Atomic Energy Agency (1972).

From Radiotracer Studies of Chemical Residues in Food and Agriculture Meeting; Vienna, Austria (25 Oct 1971). See STI/PUB–332; CONF-711069–.

The metabolism of organophosphorus insecticides in plants involves several different enzyme-catalyzed reactions including oxidations, hydrolyses, alkyl or aryl group transfers, reductions, and conjugations; frequently the products of these reactions are also potentially harmful. Therefore, the development of effective conventional techniques for monitoring organophosphorus insecticides and others in plant products or in the environment is dependent on a complete knowledge of the fate of the chemical after it is applied. The application of radiotracer methodology with compounds labeled with radioisotopes at strategic positions on the molecule has been indispensable for determining this basic information. Specific examples are discussed that illustrate the versatility of radiometric procedures in metabolism studies, and emphasize the importance of detecting all the products that are formed. (auth)

20187 POSSIBILITY OF ISOTOPE EXCHANGE OR OTHER INTERFERING REACTIONS OCCURRING DURING THE DETERMINATION OF RESIDUES FROM FUMIGATION WITH ^{32}P LABELLED PHOSPHINE. Disney, R. W.; Fowler, K. S. (Ministry of Agriculture, Fisheries, and Food, Buckinghamshire, Eng.). pp 87-88 of Radiotracer Studies of Chemical Residues in Food and Agriculture. Vienna; International Atomic Energy Agency (1972).

From Radiotracer Studies of Chemical Residues in Food and Agriculture Meeting; Vienna, Austria (25 Oct 1971). See STI/PUB–332; CONF-711069–.

Parallel chemical and radiometric determinations substantiate the validity of conclusions based on the use of ^{32}P-labeled phosphine at the dilutions and comparatively low specific activity employed. It is evident that results are not significantly affected either by reactions that might arise from radiation effects or by exchange of ^{32}P with natural ^{31}P in the product. (auth)

20188 RESIDUES IN CEREALS EXPOSED TO HYDROGEN PHOSPHIDE. Disney, R. W.; Fowler, K. S. (Ministry of Agriculture, Fisheries, and Food, Slough, Eng.). pp 99-101 of Radiotracer Studies of Chemical Residues in Food and Agriculture. Vienna; International Atomic Energy Agency (1972).

From Radiotracer Studies of Chemical Residues in Food and Agriculture Meeting; Vienna, Austria (25 Oct 1971). See STI/PUB–332; CONF-711069–.

^{32}P-labeling of the phosphine allows direct determination of residual phosphorus compounds remaining after exhaustive removal of excess phosphine. The residue (approximately 70% water-soluble) increases with phosphine concentration, and with duration and temperature of exposure. It is also greater in samples of higher moisture content and when the product is ground. Autoradiographs of grain sections show radioactivity largely in the outer layers. (auth)

20189 FATE AND SIGNIFICANCE OF FUNGICIDES IN RICE. Tomizawa, C.; Uesugi, Y.; Murai, T. (National Inst. of Agricultural Sciences, Tokyo). pp 103-105 of Radiotracer Studies of Chemical Residues in Food and Agriculture. Vienna; International Atomic Energy Agency (1972).

From Radiotracer Studies of Chemical Residues in Food and Agriculture Meeting; Vienna, Austria (25 Oct 1971). See STI/PUB–332; CONF-711069–.

The metabolic fate of the organophosphorus fungicides, O, O-diisopropyl S-benzyl phsophorothiolate (Kitazin P and O-ethyl S, S-diphenyl phosphorodithiolate (Hinosan) that were developed as substitutes of organomercury fungicides for the control of rice blast disease, was studied by using the ^{32}P- and(or) ^{35}S-labeled compounds. Initial degradation of the fungicides in organisms including rice, fungus, and soil was hydrolysis by cleavage of the P-S or S-C linkages. While Hinosan was degraded mainly at the P-S linkage, Kitazin was degraded at either the S-C or P-S linkage though the cleavage of the former linkage was dominant. Oxidation products of phenylthio- and benzylthio-radicals such as diphenyl disulphide, dibenzyl disulphide, benzene-sulphonic acid, benzy-α-sulphonic acid, and sulphuric acid were detected. Hydroxylation of the benzene ring of phenylthio or benzylthio was found in some cases, where the phenylthio-radical was hydroxylated at the p-position and the benzylthio-radical at the m-position. Isomerization of thiolate to thionate was detected in Kitazin P. (auth)

20190 PRELIMINARY REPORT ON THE RESIDUES OF CARBARYL GRANULES IN RICE PLANTS. Huque, H. (Dept. of Plant Protection, Karachi, Pakistan). pp 107-109 of Radiotracer Studies of Chemical Residues in Food and Agriculture. Vienna; International Atomic Energy Agency (1972).

From Radiotracer Studies of Chemical Residues in Food and Agriculture Meeting; Vienna, Austria (25 Oct 1971). See STI/PUB-332; CONF-711069-.

Two-week old rice plants were treated with 10% ^{14}C-labeled carbaryl granules prepared in the laboratory. Residues were determined using TLC and radioassay techniques up to a period of 18 days after treatment. Preliminary results show that carbaryl is readily taken up by the rice plants. A carbaryl level of about 100 ppM was observed in the plants (excluding roots) after three days. Thereafter the residue level decreased gradually to about 15 ppM after 18 days. (auth)

20191 REACTIONS OF HERBICIDES WITH SOIL AND PLANTS. Suess, A.; Siegmund, H.; Eben, C.; Grampp, B. (Bayerische Landesanstalt fuer Bodenkultur, Munich, Ger.). pp 111-121 of Radiotracer Studies of Chemical Residues in Food and Agriculture. Vienna; International Atomic Energy Agency (1972).

From Radiotracer Studies of Chemical Residues in Food and Agriculture Meeting; Vienna, Austria (25 Oct 1971). See STI/PUB-332; CONF-711069-.

^{14}C-labeled herbicides (monolinuron, pyrazon, and simazine) were used for studies of their behavior in soil and plants. The degradation of these herbicides depends on soil activities. In three tested soils, simazine was quickly decomposed during the first 10 weeks and decreased steadily. Pyrazon degradation was initiated after 10 weeks, while most of the monolinuron was degraded after 20 weeks. Bacillus sphaericus, isolated from treated soil, was found to be responsible for the breakdown. 4-Chloroaniline was proved as one of the main metabolites. Mustard plants take up about 6% of the soil adsorbed monolinuron. The availability of the adsorbed monolinuron depends on the water content. The highest uptake was found at a water capacity in the soil of 60%. (auth)

20192 USE OF RADIOISOTOPES FOR A STUDY OF ETHYLENE DIBROMIDE ACTION ON LAYING HENS. Alumot (Olomucki), E.; Harduf, Z. (Volcani Inst. of Agricultural Research, Rehovot, Israel). pp 123-127 of Radiotracer Studies of Chemical Residues in Food and Agriculture. Vienna; International Atomic Energy Agency (1972).

From Radiotracer Studies of Chemical Residues in Food and Agriculture Meeting; Vienna, Austria (25 Oct 1971). See STI/PUB-332; CONF-711069-.

The uptake of macromolecules by the ovarian follicles of laying hens treated with ethylene dibromide (EDB) was studied with labeled compounds. Chick serum albumin and globulin labeled with ^{131}I and ^{125}I were injected i.v. into control and treated hens. The uptake of both fractions per whole yolk and per unit of membrane area diminished in the treated hens to about half that of the control. Similar results were obtained with labeled polyvinylpyrrolidone (M. W. 40,000). The distribution of phosphoproteins, specific for laying, was studied using ^{32}P and was similar in yolk of EDB-treated and control hens. (auth)

20193 INCREASE IN TOXICITY OF ^{14}C-INSECTICIDES WITH POLYCHLORINATED BIPHENYL COMPOUNDS. Lichtenstein, E. P. (Univ. of Wisconsin, Madison). pp 137-141 of Radiotracer Studies of Chemical Residues in Food and Agriculture. Vienna; International Atomic Energy Agency (1972).

From Radiotracer Studies of Chemical Residues in Food and Agriculture Meeting; Vienna, Austria (25 Oct 1971). See STI/PUB-332; CONF-711069-.

Polychlorinated biphenyl plasticizers (PCBs), utilized as various Aroclor compounds, were found to be toxic to human cells in tissue cultures, exhibiting ID-50 values similar to those that were noticed with p, p'-DDT. In concentrations non-toxic to houseflies and fruit flies, they increased the toxicity of dieldrin, DDT, and in particular the toxicity of several oxygen analogues of organophosphorus insecticides. It appeared that they prevented the enzymatic conversion of parathion to paraoxon and its detoxification to non-toxic water-soluble metabolites. (auth)

20194 DEVELOPMENT OF ^{135m}Ba RADIOPHARMACEUTICAL FOR SKELETAL IMAGING. Syed, I. B.; Hosain, F.; Wagner, H. N. Jr. (Johns Hopkins Medical Institutions, Baltimore). Nucl.-Med.; 11: No. 3, 291-301(15 Nov 1972).

A systematic evaluation toward development of a bone scanning agent with barium-135m is presented. The isotope was produced in a reactor with a high neutron flux. The half-life of 1.2 days and photon energy of 268 keV were most suitable for bone scanning with rectilinear scanner or gamma camera. The radiopharmaceutical consisted of ^{135m}Ba with specific activity greater than 5 mCi/mg Ba in HCl, but neutralized to pH 6.5 and made isotonic. A minimum safety factor of greater than 1000 was maintained with respect to LD_1 in the tracer doses. The radiation dose to skeleton was 1.2 rad, but to large intestine it could be as high as 4 rads per mCi of tracer dose. Intravenously injected tracer dose cleared rapidly from the blood, and about 60% accumulated in the skeleton and 40% excreted mostly in the feces. Satisfactory scans were obtained at 1 and 2 days following laxatives. Interference from the gastrointestinal radioactivity was regarded as the major disadvantage. (auth)

20195 FRONTIERS OF NUCLEAR MEDICINE. Horst, W. (ed.) New York; Springer-Verlag (1971). 320p. (In German and English).

Separate abstracts were prepared for 11 of the 25 papers appearing in this book. The other papers discuss various techniques in nuclear medicine. (ERB)

For abstracts of individual papers see: 19752, 19753, 20099, 20141, 20161, 20162, 20172, 20173, and 20196-20198.

20196 AXIAL SKELETAL SCINTIGRAPHY IN MAMMARY CARCINOMA. Galasko, C. S. B. (Royal Postgraduate Medical School and Hammersmith Hospital, London). pp 46-58 of Frontiers of Nuclear Medicine. Horst, W. (ed.). New York; Springer-Verlag (1971).

The axial skeleton is the commonest site for distant metastases of mammary carcinomas. Since extensive destruction of bone must be present before metastatic lesions can be diagnosed radiologically, studies were conducted to determine the efficiency of scintiscanning for diagnosis of symptomless lesions. Carbon-11, fluorine-18, and strontium-87 m were compared. The results indicated that 24% of the patients with early mammary cancer had occult metastases at the time of mastectomy. Skeletal lesions were found in 84% of the patients with advanced mammary cancer. In all patients, better results were obtained with ^{18}F than with ^{87m}Sr. Carbon-11 administered as $^{11}CO_2$ did not localize either in the normal bone or in the metastases. (ERB)

20197 ANIMAL EXPERIMENTS AND CLINICAL INVESTIGATIONS TO DEMONSTRATE THE ALVEOLO-VASCULAR (Euler-Liljestrand) reflex. Schiehe, H.; Wolf, K. J. (Univ., Ulm, Ger.). pp 218-229 of Frontiers of Nuclear Medicine. Horst, W. (ed.). New York; Springer-Verlag (1971). (In German)

A method of perfusion scintigraphy using ^{99m}Tc and ^{113}In was worked out on dogs with experimentally produced airways obstruction in an attempt to obtain a quantitative evaluation of tests for the Euler-Liljestrand reflex. The method was successfully reproduced in patients, although results must be regarded as preliminary only. (auth)

20198 PRESENT PROSPECTS FOR POSITIVE TUMOR LOCALIZATION BY SCINTISCAN. Altenbrunn, H. J. (Robert-Roessle Klinik, Berlin). pp 230-249 of Frontiers of Nuclear Medicine. Horst, W. (ed.). New York; Springer-Verlag (1971). (In German).

In order to determine the feasibility of positive tumor localization with existing equipment, laboratory tests were performed with hollow cubes of 10, 15, 20, and 40 mm side, some filled with radioactive material. Results were encouraging. Animal experiments were carried out on Wistar rats with Yoshida sarcoma to test the tumor-enriching potential of eleven substances labelled with various radioisotopes. The most successful of these, ^{131}I human fibrinogen and ^{131}I antihuman fibrinogen, gave an indication of malignancy in 21 out of 26 patients in whom their diagnostic potential was tested. Preliminary trials with ^{131}I-labeled tumor antibodies from which 90 to 95% of cross-reacting antibodies had been removed showed that an enrichment of up to 70 times could be obtained in uv-induced tumors in mice and up to 30 times in lymph-node metastases in a human patient. Such a procedure offers in addition the exciting prospect of treating distant metastases by the injection of γ-labeled antibodies. (auth)

20199 INVESTIGATION OF THE EFFECT EXERTED ON THE BIOLOGICAL ACTIVITY OF ^{131}I FIBRINOGEN BY DIFFERENT LABELLING METHODS. Sadovska, B.; Pshona, B.; Vagner, M.; Russin, K. (Inst. of Nuclear Research, Swierk, Poland). Isotopenpraxis; 8: No. 8, 297-299(Aug 1972). (In Russian).

The influence of different labeling methods on the biological activity of human and cattle ^{131}I fibrinogen was investigated. Labeling was done electrolytically using chloramine T and through direct iodation with ICl. The biological activity was determined by means of the thrombine test involving determination of the coagulation capability of fibrinogen. The electrolytic method proved to be the most suitable one, providing not only good radiochemical yield, but also the least effect on the biological activity. (auth)

20200 EFFECT OF CHEMICAL AND ENZYMATIC RADIOIODINATION ON IN VITRO HUMAN Clq ACTIVITIES. Heusser, C.; Boseman, M.; Nordin, J. H.; Isliker, H. (Univ., Lausanne, Switzerland). J. Immunol.; 110: No. 3, 820-828(Mar 1973).

Conditions are described whereby human Clq serum glycoprotein may be enzymatically radioiodinated with full retention of hemolytic activity. A comparison was made between the chloramine T (CT) and lactoperoxidase (LP) methods of iodination, which indicates the following: Clq may be iodinated to a level of 0.2 atoms iodine/molecule by using LP with no detectable loss in hemolytic activity, whereas, at a level of 0.02 atoms incorporated/molecule with CT, Clq is only 50% active. Thus the hemolytic activity of Clq is quite labile to either low levels of iodide incorporation or the oxidizing conditions of the labeling procedure. Its ability to bind immune complexes, conversely, is virtually resistant to the levels and conditions of iodination reported. With either labeling method, iodide is incorporated exclusively into only the smallest of the three covalently bonded subunits. (auth)

MATERIALS

Ceramics and Cermets

Refer also to abstracts 19673, 20290, 20400, 21571, 21572, 21617, and 21912.

20201 (AECL-4374) ONE-DIMENSIONAL DIFFUSION WITH TIME-DEPENDENT BOUNDARY CONCENTRATIONS AND DIFFUSION COEFFICIENT. Lee-Whiting, G. E. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs). Jan 1973. 29p. Dep. NTIS (U. S. Sales Only). AECL $1.00.

Laplace transforms are used to obtain a conveniently convergent form of the solution to the problem of one-dimensional diffusion over a finite range with arbitrary initial values and arbitrary time-dependent boundary concentrations. Time dependence of the diffusion coefficient is permitted. A conveniently convergent series representation is obtained for the time-integrated flow across a boundary, a quantity for which no generally valid formula appears to have been available previously. (auth)

20202 (HEDL-SA-230) EFFECTS OF VARIOUS ATMOSPHERES ON THE ELECTRICAL PROPERTIES OF Al_2O_3. Schemmel, R. R.; Gordon, R. L. (Hanford Engineering Development Lab., Richland, Wash.). 11 Oct 1971. Contract AT(45-1)-2170. 40p. (CONF-711030-9). Dep. NTIS.

From 24th Pacific Coast Regional Meeting of the American Ceramic Society; Anaheim, California, United States of America (USA) (30 Oct 1971).

Results of transient effects, due to time at temperature in atmospheres of air, vacuum, helium, or argon–8% hydrogen on the electrical properties of an alumina sample similar in composition to a typical electrical connector for a high-temperature cable system are presented. The electrical-properties measurements were made as a prelude to "noise tests" and to insertion into a radiation field, with the purpose of characterizing the sample electrical response at temperatures up to 900°C. Data and discussions are included on cycling effects, transient effects at 550°C, transient effects at 815°C, and annealing effects at 325°C. (55 references) (JRD)

20203 (HEDL-SA-324) CONTROL AND BEHAVIOR OF O/M, OFFGAS AND MOISTURE DURING FABRICATION OF MIXED OXIDE (25% PuO_2–75% UO_2) FOR HEDL IRRADIATION TESTING. Chidester, K. M.; Warden, W. E. (Hanford Engineering Development Lab., Richland, Wash.). 1972. Contract AT(45-1)-2170. 24p. (CONF-720525-6). Dep. NTIS.

From 74th Annual Meeting of the American Ceramic Society; Washington, District of Columbia, United States of America (USA) (6 May 1972).

Information concerning processes for production of fuels to RDT specifications is presented. Discussions are included on oxygen–metal (O/M) ratio control and moisture control. It is noted that mixed oxide fuel pellet O/M ratio may be expected to drift in storage after sintering if the pellets have the propensity to drift and are not kept free from moisture and oxygen. Fuel should be stored after sintering in vacuum or rightly sealed containers impervious to moisture and oxygen if O/M stability is desired. (JRD)

20204 (HEDL-SA-325) FABRICATION OF 90-PERCENT-DENSE FUEL FOR IRRADIATION TESTING. Warden, W. E.; Chidester, K. M. (Hanford Engineering Development Lab., Richland, Wash.). 1972. Contract AT(45-1)-2170. 20p. (CONF-720525-7). Dep. NTIS.

From 74th Annual Meeting of the American Ceramic Society; Washington, District of Columbia, United States of America (USA) (6 May 1972).

Processes developed for fabricating 90% theoretical dense fuel on a pilot plant scale are described. The first process is the "high-pressure preslug" process and the second process is the "dry" process. These pilot-plant results indicate that a production line can be designed to fabricate 90%-theoretical-density fuel for the FFTF using either the "high-pressure preslug" or "dry" process approaches. The "dry" process appears better, because it is less time consuming, easier to control, simpler to modify, and has produced higher yields, but it may not exhibit the good dimensional control of the "high-pressure preslug" approach. The closed porosity structure of the dry processed fuel may possibly be less susceptible to moisture absorption and oxygen-to-metal-ratio drift. (auth)

20205 (IS-2824) STUDIES ON THE Y–O, Y–C, and Y–N PHASE SYSTEMS. Carlson, O. N.; Lichtenberg, R. R.; Warner, J. C. (Iowa State Univ. of Science and Technology, Ames). 1972. 28p. (CONF-720978-1). Dep. NTIS.

From 7th conference on rare-earth metals alloys and compounds; Moscow, USSR (12 Sep 1972)

Revised diagrams are proposed for the Y–Y_2O_3 and Y–YC_2 systems and a new diagram proposed for the Y–YN system. The stoichiometric compositions, crystal structures, and lattice parameters of the intermediate phases are summarized. Particular emphasis is given to the determination of the yttrium solvus curves for each system including the experimental results on which they have been based. The temperature dependence of the solubility of each solute in α yttrium has been fitted empirically to the following Arrhenius-type equations: log at. % oxygen = $2.172 - 6775/2.303\ RT$; log at. % carbon = $1.923 - 7992/2.303\ RT$; and log at. % nitrogen = $1.918 - 11618/2.303\ RT$. The heats of solution for the co-existing oxide, carbide, or nitride in α-yttrium obtained from the above relationships are 6.8 ± 0.4, 8.0 ± 1.0, and 11.6 ± 1.3 kcal/mole, respectively. (12 figs., 18 references) (auth)

20206 (RDT-F-11-4-T(9-72)) DETERMINATION OF A FIGURE OF MERIT FOR PuO_2–UO_2 FUEL PELLET HOMOGENEITY BY USE OF AN ELECTRON MICROPROBE. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Sep 1972. 24p. RSO.

A standard prescribing requirements for determination of a figure of merit for PuO_2–UO_2 fuel pellet homogeneity by use of an electron microprobe is presented. (JRD)

20207 (RDT-F-11-6-T(1-73)) CERAMOGRAPHIC PREPARATION OF MIXED OXIDE FUEL PELLETS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1973. 10p. RSO.

A standard prescribing requirements for ceramographic preparation of mixed-oxide fuel pellets for nuclear and associated applications is presented. (JRD)

20208 (TM-65-9-26) TEST OPERATING REPORT ORFY-1. Stevenson, D. B. (General Electric Co., Idaho Falls, Idaho. Nuclear Materials and Propulsion Operation). 15 Sep 1965. Contract AT(40-1)-2847. 7p. Dep. NTIS.

Declassified 4 Nov 1971.

Test capsule ORFY-1, containing three yttrium uranium hydride specimens, was irradiated for 46.4 hours at a maximum indicated specimen temperature of 955°C in core position F-2 of the ORR. The test was terminated after the occurrence of an abrupt shift downward in the readings of the specimen thermocouples. Post-irradiation examination of the capsule assembly revealed no obvious reason for the shift in indicated temperature. (auth)

20209 (UCRL-Trans-10673) CERMETS: NEW DEVELOPMENTS. Kieffer, R.; Eipeltauer, E.; Gugel, E. Translated from Ber. Deut. Keram. Ges.; 46: No. 9, 486-492(1969). 24p. Dep. NTIS.

Although metal–metal oxide materials as such are not new, in recent times they have gained new significance by the name of cermets. Sintered alloys from hard metallic materials and additives such as, for example, hard metals should not be included in the cermet group of materials. The nature of the bond in cermets–a compromise combination of favorable and unfavorable properties of the metals and of the oxides–is discussed in detail and the compositions and field of application of both classical and new cermets are outlined. Such combinations as Mo–ZrO_2, Mo–UO_2, Ni–ThO_2, and SiC–Si are technologically interesting examples of cermets. The powder metallurgy, or more precisely the sintering and hot-pressing techniques, and the impregnation process have been given an impetus by the development in the field of cermets. These developments have also had beneficial effects on such fields as those of high-temperature materials, cutting tool ceramics, electronics, space travel, and production of nuclear energy. (auth)

20210 METHOD FOR PREPARING STABLE ACTINIDE PEROXIDE SOLS. Petit, G. S.; Kienberger, C. A. (to United States Atomic Energy Commission). U. S. Patent 3,697,441. 10 Oct 1972. Filed 8 Dec 1970.

The method comprises precipitating the actinide as a peroxide from an acid solution at a pH of −0.5 to 1.5 and thereafter separating and suspending the actinide peroxide precipitate in water or a dilute hydrogen peroxide solution to form the actinide peroxide sol. (Official Gazette)

20211 SPECIFIC HEAT FROM 35 TO 300 K FOR PLUTONIUM SESQUICARBIDE Pu_2C_3. Danan, J. (CEN, Fontenay-aux-Roses, France). J. Nucl. Mater.; 45: No. 4, 339-340(Jan 1973). (In French).

The specific heat of Pu_2C_3 was measured in the range from 35 to 300°K. From the curve obtained it was shown that the specific heat of U_2C_3 is higher than that of Pu_2C_3. After extrapolation of the experimental curve to 0°K, the thermodynamic functions of Pu_2C_3 at 298.15°K were evaluated as $S = 128 + 8$ J mole^{-1} K^{-1}, $H - H_0 = 19.2 \pm 1.2$ kJ mole^{-1}, and $-(G - H) = 18.8 \pm 1.2$ kJ mole^{-1}. (JSR)

20212 CERAMICS IN SEVERE ENVIRONMENTS. Proceedings of the Sixth University Conference, Raleigh, North Carolina, December 7–9, 1970. Kriegel, W. W.; Palmour, H. III (eds.). Materials Science Research, Volume 5. New York; Plenum Publishing Corporation (1971). 626p. $28.00. (CONF-701206).

Thirty seven papers are included in the volume. A separate abstract was prepared for each of 19 papers selected as in the scope of NSA. One paper was previously abstracted in NSA as 25: 19273. (JRD)

For abstracts of individual papers see: 20213–20229, 20323, and 20394.

20213 OXIDATION OF BORON NITRIDE IN AN ARC-HEATED JET. Buckley, J. D. (Langley Research Center, Hampton, VA). pp 27-34 of Ceramics in Severe Environments. Kriegel, W. W. (ed.). New York; Plenum Publishing Corp. (1971).

From conference on Ceramics in Severe Environments; Raleigh, North Carolina, United States of America (USA) (7 Dec 1970). See CONF-701206–.

Two grades of hot-pressed boron nitride and a boron nitride composite were subjected to oxidation tests in a 2.5-MW atmospheric arc jet. The results showed that fabrication and/or composition influenced thermal shock and oxidation resistance. Changes in surface structure and recession due to oxidation suggest correlation with specimen composition. The boron nitride composite reacted with the O in the hot subsonic airstream to produce a glassy coating on the hot face surface. (auth)

20214 MICROSTRUCTURAL FEATURES OF OXIDE SCALES FORMED ON ZIRCONIUM DIBORIDE MATERIALS. Graham, H. C. (Aerospace Research Labs., Wright-Patterson AFB, OH); Davis, H. H.; Kvernes, I. A.; Tripp, W. C. pp 35-48 of Ceramics in Severe Environments. Kriegel, W. W. (ed.). New York; Plenum Publishing Corp. (1971).

From conference on Ceramics in Severe Environments; Raleigh, North Carolina, United States of America (USA) (7 Dec 1970). See CONF-701206–.

Both ZrB_2 and ZrB_2 + 20 vol. % SiC have been oxidized in O over the range 900 to 1500°C. The microstructural features of the oxide scales formed under these conditions are studied as a function of temperature and reaction time. Techniques used to characterize the oxide products include x-ray diffraction, scanning electron microscopy, and electronprobe microanalysis. A glassy B_2O_3 is one of the oxidation products at temperatures below 1100°C, resulting in protective behavior. At higher temperatures, the formation of an SiO_2-base glass imparts additional protection to ZrB_2 + 20 vol.% SiC. (auth)

20215 OPTIMUM PROPERTIES OF ZIRCONIA CERAMICS FOR HIGH-PERFORMANCE STORAGE HEATERS. Fehrenbacher, L. L. (Aerospace Research Labs., Wright-Patterson AFB, Ohio). pp 105-122 of Ceramics in Severe Environments. Kriegel, W. W. (ed.). New York; Plenum Publishing Corp. (1971).

From Conference on Ceramics in Severe Environments; See CONF-701206–.

The simulation of true supersonic flight conditions for the development of hypersonic air breathing propulsion systems is a current objective of the Air Force. Heat transfer, aerodynamic heating and propulsion problems associated with re-entry and hypersonic flight within the atmosphere have led to the use of ceramic storage heaters for the source of high temperature air in hypersonic "blow down" wind tunnels. Descriptions are presented of typical operating conditions, role of thermal, mechanical, chemical, and microstructural properties of zirconia ceramics in heater design optimization, engineering evaluation tests on bed and insulation materials, and results of in-service performance of operating heaters. (auth)

20216 THERMAL-SHOCK-RESISTANT MATERIALS. Rossi, R. C. (Aerospace Corp., El Segundo, CA). pp 123-136 of Ceramics in Severe Environments. Kriegel, W. W. (ed.). New York; Plenum Publishing Corp. (1971).

From Conference on Ceramics in Severe Environments; Raleigh, North Carolina, United States of America (USA) (7 Dec 1970). See CONF-701206–.

Aerospace applications which take advantage of the refractory nature of ceramic materials also impose upon them severe conditions of thermal shock. The severity of this thermal environment exceeds that for which it is possible to prevent crack nucleation; therefore, the design of thermal-shock-resistant materials is based on the concept of preventing crack propagation. More explicitly, composite materials with either carbide or oxide matrices were developed with the capability of sustaining thermal strains without generating the thermal stresses that could lead to catastrophic failure. Thermal simulation tests revealed a resistance to thermal shock far superior to that which could be realized by more conventional ceramic materials. Improved quality is related to the role of the individual phases within the microstructures. Data are cited for ZrC–C, BeO–SiC and MgO–W composites. (auth)

20217 FACTORS AFFECTING THE THERMAL-SHOCK BEHAVIOR OF YTTRIA-STABILIZED HAFNIA-BASED GRAPHITE AND TUNGSTEN COMPOSITES. Lineback, L. D.; Manning, C. R. (North Carolina State Univ., Raleigh). pp 137-147 of Ceramics in Severe Environments. Kriegel, W. W. (ed.). New York; Plenum Publishing Corp. (1971).

From Conference on Ceramics in Severe Environments; Raleigh, North Carolina, United States of America (USA) (7 Dec 1970). See CONF-701206–.

Hafnia-based composites containing either graphite or W were investigated as rocket-nozzle-throat inserts in solid-propellant rocket engines. The thermal-shock resistance of these materials is considered in terms of macroscopic thermal conductivity, thermal expansion, modulus of elasticity (E) and compressive fracture stress (σ_F). The effect of degree of hafnia stabilization, density, and graphite or W content upon these parameters is discussed. The variation of the σ_F/E ratio with density and its effect upon thermal shock resistance of these materials is discussed in detail. (auth)

20218 THERMAL-SHOCK-RESISTANT ZIRCONIA NOZZLES FOR CONTINUOUS COPPER CASTING. Jaeger, R. E. (Bell Telephone Labs., Inc., Murray Hill, NJ); Nickell, R. E. pp 163-184 of Ceramics in Severe Environments. Kriegel, W. W. (ed.). New York; Plenum Publishing Corp. (1971).

From conference on Ceramics in Severe Environments; Raleigh, North Carolina, United States of America (USA) (7 Dec 1970). See CONF-701206–.

A partially stabilized zirconium oxide nozzle to be used in a continuous copper casting process was designed to adequately resist thermal shock and was satisfactorily tested in the operating environment. The zirconia has an optimized stabilizer content in terms of free thermal expansion characteristics and high-temperature tensile strength. The optimization is achieved through control of composition, microstructure, and crystallographic transformation during the heating cycle. Results of thermal and stress analyses of the design indicate a positive safety margin subsequently borne out by production testing. (auth)

20219 COMPRESSIVE STRENGTH OF CERAMICS. Rice, R. W. (Naval Research Lab., Washington, DC). pp 195-229 of Ceramics in Severe Environments. Kriegel, W. W. (ed.). New York; Plenum Publishing Corp. (1971).

From Conference on Ceramics in Severe Environments; Raleigh, North Carolina, United States of America (USA) (7 Dec 1970). See CONF-701206–.

The literature on compressive strengths of crystalline ceramics, especially at room temperature, suggests that microplasticity may be the mechanism of much compressive failure since (1) the yield stress (microhardness/3) is the upper limit of both ambient- and elevated-temperature compressive strengths and (2) data on grain size dependence are consistent with the Petch equation. A failure theory is developed that is in accord with (1) experimentally observed variations in microhardness and compressive-strength data, (2) stress concentrations due to thermal and mechanical anisotropies, impurities, pores and flaws, and (3) twin-induced premature fracture. Applicability of the theory is evaluated for crystalline ceramics in terms of conventional flaw theories, and relevance for noncrystalline ceramics is discussed. (134 references) (auth)

20220 FRACTOGRAPHY OF HIGH-BORON CERAMICS SUBJECTED TO BALLISTIC LOADING. Katz, R. N.; Brantley, W. A. (Army Materials and Mechanics Research Center, Watertown, MS). pp 271-282 of Ceramics in Severe Environments. Kriegel, W. W. (ed.). New York; Plenum Publishing Corp. (1971).

From Conference on Ceramics in Severe Environments; Raleigh, North Carolina, United States of America (USA) (7 Dec 1970). See CONF-701206–.

Fractographic studies of B_4C and AlB_{12} ceramics subjected to ballistic impact are presented. Results suggest that macroscopic textures of fracture-exposed surfaces are indicative of stress states occurring during the fracture event, whereas microscopic topography is strongly influenced as well by microstructural

features. Variation observed as a function of distance from the impact axis allows some differentiation between the strain rate sensitivity of the fracture processes of the two materials. (auth)

20221 EFFECT OF NONSTOICHIOMETRY ON CREEP OF OXIDES. Clauer, A. H.; Seltzer, M. S.; Wilcox, B. A. (Battelle Memorial Inst., Columbus, OH). pp 361-384 of Ceramics in Severe Environments. Kriegel, W. W. (ed.). New York; Plenum Publishing Corp. (1971).

From Conference on Ceramics in Severe Environments; Raleigh, North Carolina, United States of America (USA) (7 Dec 1970). See CONF-701206-.

High-temperature creep in oxides is often sensitive to stoichiometry, primarily because creep is often a diffusion-controlled process, and diffusion occurs by the movement of point defects. The point-defect concentration depends on both the type and amount of impurities present and on the ambient-oxygen pressure. Therefore, oxide stoichiometry is particularly dependent upon the environment at high temperatures, where diffusion is rapid. The relation between the creep behavior and stoichiometry in oxides is reviewed in detail. (auth)

20222 BEHAVIOR OF REACTIVE CERAMICS IN ATMOSPHERIC ENVIRONMENTS. Accary, Andre (CEN, Saclay, France). pp 445-459 of Ceramics in Severe Environments. Kriegel, W. W. (ed.). New York; Plenum Publishing Corp. (1971).

From conference on Ceramics in Severe Environments; Raleigh, North Carolina, United States of America (USA) (7 Dec 1970). See CONF-701206-.

Using UC as an example, the reaction of highly reactive carbides was studied in different environments containing water. The aim was to elucidate the atmosphere corrosion mechanism which was found to be that of stress corrosion. Previous data were reinterpreted according to this mechanism. (auth)

20223 ELECTRODE AND INSULATION MATERIALS IN MAGNETOHYDRODYNAMIC GENERATORS. Fehrenbacher, L. L.; Tallan, N. M. (Aerospace Research Labs., Wright Patterson AFB, OH). pp 503-520 of Ceramics in Severe Environments. Kriegel, W. W. (ed.). New York; Plenum Publishing Corp. (1971).

From Conference on Ceramics in Severe Environments; Raleigh, North Carolina, United States of America (USA) (7 Dec 1970). See CONF-701206-.

The operation and service environment of open- and closed-cycle MHD generators is described. The performance characteristics of candidate electrode and insulation materials and their peculiar limitations with respect to conductivity, mechanical and electrochemical erosion, thermal shock resistance, maximum allowable surface temperature, compositional stability (polarization and contamination), thermionic emission, and over-all service life are discussed. Special emphasis is given to problems associated with the performance of various ceramic insulators and electrodes used in open-cycle generators. Recommendations for research studies on specific ceramic compositions and systems showing potential as MHD-generator-channel materials are offered. (36 references) (auth)

20224 INTERACTION BETWEEN HIGH-ENERGY RADIATION AND GLASSES. Kreidl, N. J. (Univ. of Missouri, Rolla). pp 521-536 of Ceramics in Severe Environments. Kriegel, W. W. (ed.). New York; Plenum Publishing Corp. (1971).

From Conference on Ceramics in Severe Environments; Raleigh, North Carolina, United States of America (USA) (7 Dec 1970). See CONF-701206-.

Effects of high-energy radiation depend upon the dominance of particle radiation, primarily manifested in structural changes, or ionizing electronic changes, in practice, radiations and damages are mixed. Neutron fluxes of 10^{20} nvt significantly alter crystalline and vitreous silica. High-intensity γ and x irradiation induces impurity and intrinsic color and spin centers in silica and complex oxide glasses, which can be differentiated and described in considerable detail. Induced changes can be used to prevent discoloration or, conversely, to read dosage. Such changes include absorption, luminescence, and thermoluminescence. Space charges can lead to fracture when surfaces are violated. The understanding and use of other changes are in their infancy. Relatively low-energy light in high intensity can cause mechanical damage. Thresholds are crucial in modern laser technology. (auth)

20225 USE OF COMPUTER EXPERIMENTS TO PREDICT RADIATION EFFECTS IN SOLID MATERIALS. Beeler, J. R. Jr. (North Carolina State Univ., Raleigh). pp 553-574 of Ceramics in Severe Environments. Kriegel, W. W. (ed.). New York; Plenum Publishing Corp. (1971).

From Conference on Ceramics in Severe Environments; Raleigh, North Carolina, United States of America (USA) (7 Dec 1970). See CONF-701206-.

Prediction of radiation effects requires an analysis of defect annealing in addition to the analysis of the primary damage state directly produced by irradiation. The transient and steady states associated with defect production and annealing depend upon the particular types of defect configurations possible under irradiation conditions. Many of the important defect configurations are much different in character than those that can be produced thermally. Experience has shown that the analysis of radiation effects must be based on discrete-particle interaction rather than continuum models, providing one of the main reasons for using the computer-experiment method in radiation-effects prediction. The methods used to simulate atomic-collision cascades in solids and to simulate the crucial initial stages in the subsequent defect-annealing process are described and illustrated with results from computer-experiment simulations. Special emphasis is placed upon the influence of ceramic-like precipitates on defect production and annealing in reactor structural materials. (21 references) (auth)

20226 PROCESS OF HYDROSTATIC COMPACTION OF B_2O_3 GLASS. Mizouchi, N.; Cooper, A. R. (Case Western Reserve Univ., Cleveland, OH). pp 461-476 of Ceramics in Severe Environments. Kriegel, W. W. (ed.). New York; Plenum Publishing Corp. (1971).

From Conference on Ceramics in Severe Environments; Raleigh, North Carolina, United States of America (USA) (7 Dec 1970). See CONF-701206-.

Upon application of high pressure, glass exhibits both elastic and anelastic behavior even at room temperatures. The consequence of anelastic behavior has been recognized as an "irreversible" densification. The technique developed permitted measurement of the instantaneous volume of B_2O_3 glass under hydrostatic pressure up to 22 kbar. It was observed that (1) anelastic volume strain is highly nonlinear in pressure, (2) apparent bulk viscosity may be lower than 10^{15} poise at onset of pressure application and tends to approach infinitely large value as time advances, and (3) more than one ordering parameter is necessary to be consistent with observed compaction under pressure. (auth)

20227 FAST-NEUTRON EFFECTS IN GLASS CERAMICS AND AMORPHOUS SEMICONDUCTORS. Hench, L. L.; Tuohig, W. D.; Clark, A. E. (Univ. of Florida, Gainesville). pp 575-586 of Ceramics in Severe Environments. Kriegel, W. W. (ed.). New York; Plenum Publishing Corp. (1971).

From Conference on Ceramics in Severe Environments; Raleigh, North Carolina, United States of America (USA) (7 Dec 1970). See CONF-701206-.

A review of radiation-damage mechanisms in insulators and semiconductors is presented. Recent results on fast neutron effects on the ac and dc electrical properties of insulating glass-ceramics, amorphous semiconductors, and semiconducting glass ceramics, including damage thresholds of crystallite sizes, are discussed and interpreted in terms of amorphous band-structure models and heterogeneous dielectric theory. (auth)

20228 FABRICATION AND IRRADIATION BEHAVIOR OF URANIUM MONONITRIDE. Tennery, V. J.; Washburn, T. N.; Scott, J. L. (Oak Ridge National Lab., TN). pp 587-599 of Ceramics in Severe Environments. Kriegel, W. W. (ed.). New York; Plenum Publishing Corp. (1971).

From Conference on Ceramics in Severe Environments; Raleigh, North Carolina, United States of America (USA) (7 Dec 1970). See CONF-701206-.

Uranium mononitride is a candidate fuel for nuclear reactors for applications in space because of its high thermal conductivity, high fissile-atom density, and dimensional stability at high temperature. High-purity UN ceramics fabricated from nitride powders by uniaxial or isostatic pressing, and sintered in nitrogen at temperatures >2000°C, were irradiated at fuel temperatures to 1500°C and 2 wt % burnup. Results indicate no chemical reaction zone between fuel and metallic cladding, fuel swelling less than 2.8% $\Delta V/V$ per atomic percent burnup, and maximum fission gas release of 7% of that generated. (auth)

20229 EFFECTS OF ULTRAVIOLET RADIATION ON LATTICE IMPERFECTIONS IN PYROLYTIC BORON NITRIDE. Buckley, J. D. (Langley Research Center, Hampton, VA); Cooley, James A. pp 547-552 of Ceramics in Severe Environments. Kriegel, W. W. (ed.). New York; Plenum Publishing Corp. (1971).

From Conference on Ceramics in Severe Environments; Raleigh, North Carolina, United States of America (USA) (7 Dec 1970). See CONF-701206-.

Pyrolytic boron nitride was exposed to 310 equivalent sun

hours of ultraviolet radiation in a space-environment simulator. Lattice-parameter comparisons show a definite increase in lattice imperfections in the crystal structure resulting from the ultraviolet irradiation. (auth)

20230 MAGNETIC, ELECTRICAL, AND THERMAL STUDIES ON THE $V_{1-x}Mo_xO_2$ SYSTEM WITH $O \leq x \leq 0.20$. Hoerlin, T.; Niklewski, T.; Nygren, M. (Univ. of Stockholm). Mater. Res. Bull.; 8: No. 2, 179-189(Feb 1973).

The monoclinic-to-tetragonal structure transition of oxides $V_{1-x}Mo_xO_2$ with $O \leq x \leq 0.20$ was studied by means of DTA, x-ray diffraction, magnetic susceptibility (powder samples), and electric conductivity (single crystals) measurements within the temperature region 80 to 400°K. A linear decrease of the transition temperature of 11°K per atom % Mo was observed. The magnetic susceptibility of the low-temperature phase was found to be temperature-independent paramagnetic for all preparations. Electrical conductivity measurements on the same phase showed crystals with $x \leq 0.04$ to be semiconducting, while a metallic behavior was observed in the region $0.10 \leq x \leq 0.14$. (27 references) (auth)

20231 IMPORTANCE OF CHARACTERIZING UO_2 POWDERS FOR SINTERING. Nishioka, I. Metalurgia (Sao Paulo); 28: No. 170, 31-39(Jan 1972). (In Portuguese).

The necessity of studying a group of properties rather than relying on a single property in determining the suitability of a given lot of powder for the production of fuel elements is stressed. To illustrate the influence of the origin of the ammonium diuranate (ADU) on the sinterability of UO_2 powder, powders prepared from two different lots of ADU were studied and processed into pellets. One lot, designated ADU-S, had been precipitated with ammonia from a solution of uranyl sulfate and purified by ion exchange. The other was also precipitated with ammonia, but from a solution of uranyl nitrate, and purified by solvent extraction. The results indicated that the powder of ADU-N origin would produce sintered pellets of higher density than the powder of ADU-S origin, even though the green density of compacted pellets of the latter material was higher. The percentage of theoretical density obtained for the sintered pellets made from UO_2-N was 94.5 and 96.4, respectively, for compaction pressures of 1.3 and 2.7 tons/cm^2 as against 87.9 and 88.9 for the pellets made of UO_2-S powder. (31 references) (Metals Abstr.)

20232 MOLYBDENUM CORNER OF THE TERNARY SYSTEMS Mo–Ti–B AND Mo–Zr–B. Zakharov, A. M.; Pol'kin, V. S. (Moscow Inst. of Steel and Steel Alloys). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 4, 109-113(1972). (In Russian).

The phase–composition relationships were studied for Mo alloys containing up to 1% B and 8% Ti or Zr, and the combined solubilities of Ti and B, or Zr and B, in Mo in the solid state were measured in the temperature range 1950 to 1200°C. Electron microscopy, x-ray analyses, etching tests, and microhardness studies supplemented visual observations on the alloys. Polythermal cross sections from 1000 to 2800°C were constructed for Mo–TiB_2 and for Mo–ZrB_2. Isothermal cross sections at the temperatures 1950 and 1200°C were drawn for the system Mo–Zr–B. (KSW)

20233 MORPHOLOGY OF TETRAGONAL BORON FILAMENTS. Sugaya, T. (Ohkura Electric Co., Tokyo); Takeuchi, Y.; Watanabe, O. Phys. Status Solidi (a); 15: No. 1, K5-K6(16 Jan 1973).

Experimental details are reported for the pyrolysis and morphology of filamentary B crystals, starting with a BBr_3-H_2 mixture. The kinked and straight crystals that were grown on the carbon fiber tow ranged from 0.1 to 0.4 μm in cross section and were ~70 μm long. The crystal structure is tetragonal, with a = 8.57 Å and c = 5.47 Å. The preferential growth direction is parallel to the ⟨121⟩ axis. The plane of the kink is parallel to the $(\bar{2}10)$ plane, and an angle at the kink corresponds to the angle between [121] and $[12\bar{1}]$ axes. Spherical single crystals on the filament are also observed. (DLC)

20234 PREPARATION OF SINGLE-CRYSTAL OR AMORPHOUS BeO LAYERS DURING REACTIVE EVAPORATION OF BERYLLIUM. Gruner, H.; Moellenstedt, G. (Univ., Tuebingen, Ger.). Thin Solid Films; 14: No. 1, 43-47(1 Dec 1972). (In German).

Layers of BeO were formed in an ultrahigh vacuum system by reactive evaporation of Be according to Auwärter at a partial O_2 pressure of 10^{-2} Pa. The BeO layers, which were of an arbitrary thickness, show almost no absorption in the visible wavelength range and may be prepared with surface resistivities (i.e. ratio of resistivity to thickness) greater than 10^{12} Ω. With decreasing thickness of the BeO layers and with decreasing temperature of the substrate, the grain size becomes smaller. If the substrate is kept at liquid air temperature, amorphous BeO layers are obtained which are of interest for electron microscopical purposes because of their low mass thickness and high resistance to chemicals. Under intense electron bombardment, thin extended monocrystalline BeO foils are formed by recrystallization processes. (auth)

20235 STRUCTURE AND MORPHOLOGY OF NIOBIUM SUBOXIDES. Monfort, Y.; Maisseu, A.; Allais, G.; Deschanvres, A.; Delavignette, P. (Group de Cristallographie et Chimie du Solide, Caen, France). Phys. Status Solidi (a); 15: No. 1, 129-142(16 Jan 1973).

The first stages of oxidation of niobium (NbO_x) were studied by electron microscopy. Two phases, called NbO_x I and II, were detected. Niobium was oxidized by a wet argon flow on thin foils or powders, heated at temperatures from 350 up to 400°C. NbO_x I, which has the composition Nb_8O to $Nb_{8.5}O$, is tetragonal: a = b = 3.38 Å and c = 3.27 Å. Superstructure spots appear in electron diffraction which are not simple fractions of the basic reciprocal lattice. This superstructure is explained by a particular occupation of interstitial sites of niobium. The NbO_x II phase, corresponding to the composition Nb_8O, is tetragonal too, with a = b = 3.34 Å and c = 3.278 Å. It is characterized by a superstructure $a' = 4\ d_{110}Nb$, $b' = 4\ d_{\bar{1}10}Nb$, $c' = 3\ d_{001}Nb$ (the small deformations being neglected). The structure of NbO_x II was determined. (auth)

20236 INTERSTITIAL SUPERSTRUCTURES OF VANADIUM DEUTERIDES. Asano, H.; Hirabayashi, M. (Tokoku Univ., Sendai). Phys. Status Solidi (a); 15: No. 1, 267-279(16 Jan 1973).

The phase diagram and crystal structure of vanadium–deuterium alloys were studied by means of neutron and x-ray diffraction, as well as by heat-capacity measurements. In addition to a disordered solid solution (α phase), the following three ordered phases were found at relatively low temperatures: a β phase or V_2D superstructure (space group Cm or $I4_1/amd$) below 130°C, a γ phase or V_4D_3 superstructure (Pcc2) below −125°C, and a δ phase or VD_{1-x} superstructure (Pnnn) below room temperature. (auth)

20237 PROPERTIES OF THE α PHASE OF HYDROGEN–TRIVALENT LANTHANIDE SYSTEMS. Daoun, J. N.; Viallard, R. (Centre National de la Recherche Scientifique, Paris). pp 76-79 of International Congress on Hydrogen in Metals. Vols. 1 and 2. Paris; Editions Science et Industrie (1972). (In French).

From International Congress on Hydrogen in Metals Conference; Paris, France (29 May 1972). See CONF-720571–(Vols. 1 and 2).

Within certain temperature and concentration limits, a single α phase is always formed between trivalent lanthanides and H or D. The resistivities of most of the Ln-H (or D) systems were measured. The important role played by the elastic properties of the solvent metals in determining the solubility of H or D in the α phase is discussed. Only the Tm and Lu form solid solutions in the α^* phase at low temperatures. Resistivity and x-ray crystallographic studies of the Lu–H (or D) system and NMR studies of the Lu–H system indicate the different locations of the interstitial element: the octahedral interstices for the α^* phase and the tetrahedral interstices for the α phase. (FR)

20238 CONTACT REACTION OF REFRACTORY COMPOUNDS WITH LIQUID METALS. II. Reaction of Carbides of Subgroup Va and VIa Metals with Liquid Transition Metals. Samsonov, G. V.; Panasyuk, A. D.; Kozina, G. K.; D'yakonova, L. V. (Inst. of Materials Science, Kiev). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 8, 629-631(Aug 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 8, 35-37(Aug 1972).

Various methods of analysis were used to establish that reactions, whose character depends on the nature of both the carbide and the metal, take place in systems composed of carbides of subgroup Va–VIa metals and the iron-group metals. The main process occurring at the interface is the formation of solid solutions. However, the character of wetting of carbides of subgroup Va and VIa metals by the iron group metals varies, which is attributable to differences in the electronic structures of the carbide phases. According to the model of configurational localization of valence electrons, carbides of subgroup Va metals are characterized, on the one hand, by a high degree of localization of the valence electrons of the metal atoms and, on the other, by stabilization of the sp^3 states of carbon by the unlocalized valence electrons of the metals. For carbides of subgroup VIa metals, localization of d electrons is a maximum, while the degree of stabilization of sp^3 states is much less. Consequently, in carbides of subgroup Va the Me—C bond is stronger than in carbides of Subgroup VIa metals, in which Me—Me bonds play the dominant role. During the reaction of carbides of Subgroup Va and VIa metals with the iron group metals, stabilization of the sp^3 states of the carbon atoms in the carbides is increased by the un-

localized electrons of the wetting metals, and it is this circumstance that is responsible for good wetting and the formation of solid solutions in these systems. (auth)

20239 HIGH-TEMPERATURE OXIDATION OF ZIRCONIUM AND HAFNIUM OXYCARBIDES AND OXYCARBONITRIDES. Zhilyaev, V. A.; Zainulin, Yu. G.; Alyamovskii, S. I.; Shveikin, G. P. (Inst. of Chemistry, Sverdlovsk, USSR). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 8, 632-636 (Aug 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 8, 38-43(Aug 1972).

A study was made, using a derivatographic technique, of the oxidation of powdered zirconium and hafnium oxycarbides, oxynitrides, and oxycarbonitrides in air at up to 950°C. The hypothesis is advanced that the oxidation process of the carbides and oxycarbides investigated involves passage through the stage of intermediate MeO_2C type phases (Me = Zr or Hf). (auth)

20240 EFFECT OF SINTERING ATMOSPHERE ON THE QUALITY OF POWDER METALLURGICAL HARD ALLOYS CONTAINING ZIRCONIUM AND HAFNIUM CARBIDES. Chaplygin, F. I.; Vitryanyuk, V. K.; Morozov, V. V. (Kiev Engineering Inst.). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 8, 666-668(Aug 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 8, 81-84(Aug 1972).

An investigation was carried out into the sintering of hard alloys containing the complex carbides $ZrC_{x\leq 1}$–WC and $HfC_{x\leq 1}$–WC in various atmospheres. It was established that, irrespective of the type of packing material employed, alloy specimens rupture during sintering at temperatures of 400 to 1520°C in hydrogen and argon atmospheres of commercial purity. It is shown that the rupture of specimens is mainly due to the presence of water vapor and oxygen in the heating chamber of the furnace, which oxidize the zirconium and hafnium carbides in the solid solutions, bringing about a change in the volume of the constituents. Sintering in a hydrogen atmosphere of spectral purity and in a vacuum does not lead to specimen rupture and makes it possible to produce dense alloys with a satisfactory structure. (auth)

20241 FUEL PARTICLES WITH LAYERS WHICH HAVE NO PROPERTY GRADIENTS. Huschka, H.; Schmutz, H.; Vygen, P. to Nuclear-Chemie und -Metallurgie GmbH). German Patent 2,036,545. 6 Apr 1972. 11p. (In German).

Methods are described for the preparation of coated nuclear fuel particles with layers of pyrolytic carbon having no unidirectional or alternating property gradients. The coating thickness is controlled and kept constant by the amount of coating gas per unit time and per coated surface, by the removal of part of the particles from the fluidized bed during the coating, or by increasing the flow of the coating gas or its concentration during the coating. The coating rate is equal to the maximum rate in the characteristic coating zone. The agreement of the overall coating rate and that of the maximum rate is achieved by using a gas conducting tube containing a defined volume and a defined amount of particles, or by the inclusion of plates of multifold nozzles as a gas inlet. (GF)

20242 NUCLEAR FUEL WITH LOW GAS RELEASE AND METHOD OF ITS PREPARATION. Pechin, W. H.; Bradley, R. A.; Sease, J. D. (to United States Atomic Energy Commission). German Patent 2,127,349. 6 Apr 1972. 9p. (In German).

Nuclear fuel consisting of a solid solution of plutonium and uranium oxides is described, with the ratio of surface to volume being greater than 100 $in.^{-1}$. The amount of gas released by the fuel is less than 0.1 cm^3/g of fuel, preferably even less than 0.05 cm^3/g. It is prepared from the oxidic fuel material subjected to heat treatment in an inert atmosphere under conditions expedient for the transformation of the material into a hyperstoichiometric state. The primary fuel can consist of microspheres measuring from 50 to 500 μ in diameter, with a density of more than 90% of theoretical. The transformation into the hyperstoichiometric state can be done by heating the fuel up to 800°C in a hydrogen-containing atmosphere. The hyperstoichiometric fuel is then cooled down to room temperature in an inert atmosphere. (GF)

20243 METHOD FOR PREPARATION OF A NUCLEAR FUEL OF URANIUM–PLUTONIUM MONOCARBIDE OR URANIUM–PLUTONIUM MONONITRIDE, RESPECTIVELY. Krauth, A.; Mueller, N. (to Nuklear-Chemie und -Metallurgie GmbH). German Patent 2,049,566. 13 Apr 1972. 11p. (In German).

A method is described for the preparation of uranium plutonium mononitride nuclear fuel in which uranium nitride powder is mixed with plutonium oxide and carbon; this mixture is pressed and reaction sintered. The uranium carbide and uranium nitride powder can be inactivated by chemical substances (which enables the handling of the powder in air). For especially dense final product the pure powders can be mixed with pre-reacted plutonium oxide and carbon. The pure powders can be prepared in granular form. Pure uranium carbide powders can be mixed with a reacted, ground, substoichiometric regulated mixture of plutonium oxide and carbon and pressed into pellets without a binding agent. The resulting reaction sintered fuel is nitrated toward the end of the sintering. Nitrogen, sulfur, and phosphorous additions can be used at the uranium plutonium carbide grains as a kind of coating having a protective effect against water and the oxygen present in the atmosphere. (GF)

20244 ELECTROLYTIC ETCHING OF SILICON CARBIDE IN PyC—SiC—PyC COATED PARTICLES. Herold, H. C.; Tassone, G.; Hausner, Hans (CCR–EURATOM, Ispra, Italy). Prakt. Metallog.; 9: No. 12, 674-678(Dec 1972). (In German and English).

A method for the preparation of ceramographic samples of coated particles and the results obtained during electrolytic etching are described. The etching of the silicon carbide layers is influenced by the presence of the pyrocarbon layers. Removal of these layers facilitates the SiC etching considerably. (auth)

20245 UNUSUAL 6R STRUCTURE IN GADOLINIUM AND SAMARIUM MONOXIDES. Bist, B. M. S.; Kumar, J.; Srivastava, O. N. (Banaras Hindu Univ., India). Z. Kristallogr.; 136: No. 1-2, 144-154(Oct 1972).

An unusual six-layered structure in gadolinium and samarium monoxides was identified employing electron-diffraction methods. This structure is derived from the zinc blende-type gadolinium or samarium monoxide. The lattice parameters of the 6R structure are $a_R = b_R = 2a_0\sqrt{2}$, $C_R = 2a_0\sqrt{3}$ (referred to hexagonal axes), where a_0 is the lattice parameter of the fundamental zinc blende-type gadolinium or samarium monoxide unit cell. A six-layered rhombohedral structure consisting of close-packed structural layers is usually not possible since it is equivalent to face-centered cubic structure. The detailed atomic structure of the 6R variant was determined. It is further shown that the stabilization of this structure is due to existence of nonstoichiometric oxygen layers in the sequence forming the 6R structure. (auth)

20246 PREPARATION OF THE C-TYPE STRUCTURE OF La_2O_3. Brauer, G.; Mohr–Rosenbaum, E. (Univ., Freiburg i. B.). Z. Anorg. Allg. Chem.; 394: No. 3, 301-304(Dec 1972). (In German).

Lanthanum oxide in the cubic C-type structure can be prepared as reported in the literature by extremely slow thermal decomposition of the hydroxide; this oxide is, however, not well crystallized. The claimed formation of pure C-type La_2O_3 by decomposition of the nitrate could not be corroborated. (auth)

20247 FORMATION OF MIXED MONOCARBIDES OF URANIUM AND TANTALUM DURING JOINT REDUCTION OF THEIR OXIDES BY CARBON. Kiselev, V. A.; Vlasov, V. G.; Bukin, V. E. J. Appl. Chem. USSR (Engl. Transl.); 45: No. 8, 1733-1736(Aug 1972).

Translated from Zh. Prikl. Khim.; 45: No. 8, 1657-1660(Aug 1972).

Mixtures of Ta_2O_5, $UO_{2.25}$, and acetylene carbon black are prepared and reacted in an evacuated furnace. The carbothermic reduction begins at about 1500°K and is complete in 15 to 20 min at 1970°K. X-ray phase analysis shows the existence of UO_2, Ta_2O_5, UC, and TaC as intermediate products. The reaction mechanism probably involves sublimation of the oxides, with the formation of TaC occurring first. The formation of a continuous series of solid solutions is confirmed. (DLC)

20248 ESR STUDY OF V_2O_5, MoO_3, AND V_2O_5–MoO_3 CATALYSTS. Mann, R. S.; Khulbe, K. C. (Univ. of Ottawa). Bull. Chem. Soc. Jap.; 45: No. 9, 2929-30(Sep 1972).

Results of ESR studies of the catalysts V_2O_5, MoO_3, and the V_2O_5–MoO_3 system are compared with results of other investigators. The ESR spectrum of Analar Grade V_2O_5(Fisher certified) showed a signal intensity ~6 times less than the V_2O_5 prepared by the investigators, thus confirming the dependence of the ESR spectrum on the method of preparation and activation of the catalyst. (LMT)

20249 PROCESS FOR THE CONVERSION OF URANIUM HEXAFLUORIDE INTO URANIUM DIOXIDE. De Hollander, W. R.; Klepfer, H. H. (to General Electric Co.). German Patent 2,147,708. 10 May 1972. 31p. (In German).

A method is described for the preparation of ceramic structures of uranium dioxide. The initial material is uranium hexafluoride which is converted to UO_2 by a reduction-hydrolysis reaction in an active flame using a carrier gas and a reducing gas. The reaction product is a uranium-rich powder which, after separation from

the other gaseous reaction products, has to be defluorinated in a certain atmosphere (e.g., moist hydrogen). The UO_2-rich powder is pressed into a structure of desired shape and dimensions which then is sintered in an atmosphere of moist hydrogen (or a mixture of H_2 and CO_2) in order to produce a structure of definite grain size and density. (GF)

20250 APPARATUS FOR THE DEPOSITION OF PYROLYTIC CARBON LAYERS. Hackstein, G. K.; Schmutz, H. (to Nuklear Chemie und -Metallurgie GmbH). German Patent 1,934,554. 20 Apr 1972. 4p. (In German).

The separation of layers of pyrolytic carbon and silicon carbide on fuel and breeder particles by thermal decomposition of gas-forming compounds is carried out in a fluidized bed. By insertion of a tube (to conduct the gas-forming substances) into the reaction tube of a fluidized bed, it was possible to separate the coating zone with an upward whirling stream of particles and the coating gas from the zone with downward-flowing relatively dense and slow-moving particles. The process gives use to completely spherical, nonpolygon pyrocarbon coatings. (GF)

20251 COMPOSITE NICKEL–BORON ELECTROLYTIC COATINGS. Fedorchenko, I. M.; Guslienko, Yu. A.; Epik, A. P. (Inst. of Materials Science, Kiev). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 8, 626-628(Aug 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 8, 31-34(Aug 1972).

The feasibility of producing composite Ni–B electrodeposits with a uniform distribution of boron particles throughout their matrix was demonstrated. Diffusional annealing leads to the formation of qualitatively new structures in such deposits and improves their physicomechanical characteristics. The wear resistance of heat-treated Ni–B deposits is as high as, and frequently much higher than, that of hard chromium electrodeposits. (auth)

20252 STRENGTH PROPERTIES OF GRAPHITE–ZIRCONIUM CARBIDE COMPOSITE MATERIALS. Dergunova, V. S.; Shurshakov, A. N.; Posos'eva, G. D.; Lutsenko, L. N. Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 8, 642-647(Aug 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 8, 51-58(Aug 1972).

Factors influencing the strength of composite materials were examined. A study was made of the strength properties of graphite–zirconium carbide and graphite–zirconium carbide–zirconium composite materials having varying structures and compositions. It was found that, at 2500°C, the tensile strength of TsG-25 type composite material is higher than that of dense VPP constructional graphite. It was established that, by varying the degree of impregnation of the zirconium phase with carbon, it is possible substantially to change the physicomechanical properties of the resultant composite material. At 20 to 2000°C, the tensile and bend strengths of materials containing residual zirconium are higher than materials containing the carbide phase alone. (auth)

20253 NONSTOICHIOMETRY AND BONDING IN TERNARY REFRACTORY CARBIDES. Hoh, M.; Jun, C. K.; Yamauchi, S. (Univ. of Cincinnati). pp 313-322 of Metallurgical Chemistry. Kubaschewski, O (ed.). London; Her Majesty's Stationery Office (1972).

From International symposium on metallurgical chemistry; London, UK (14 Jul 1971). See CONF 710738–.

The nonstoichiometry of the ternary carbides $Zr_xNb_{1-x}C_y$, $Zr_xHf_{1-x}C_y$, and $Zr_xU_{1-x}C_y$ with the sodium-chloride type structure was studied using the Knudsen method coupled with a time-of-flight mass spectrometer. From the variation of the ratio of the activities of the components with composition, the pairwise interaction energies E_{ij} were obtained and the bonding calculated. The metal–metal bonding on the metal sublattice in the carbide is the same as in the binary body-centered-cubic metals. The variation of the carbon–carbon interaction energy indicates that the metal–carbon bonds are localized. From the variation of the difference in metal–carbon interaction energy with composition, the compressibility of the carbides at elevated temperature was calculated. The values are in excellent agreement with values derived from room temperature measurements of mechanical properties. (auth)

20254 TEM OF CONDUCTING FILAMENT IN $Nb/Nb_2O_5/Bi$ SWITCHING GLASS STRUCTURE. Anderson, R. M. (IBM Components Div., Hopewell Junction, NY). pp 494-497 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

20255 MICROSTRUCTURE OF SPUTTERED SEMICONDUCTOR GLASS FILMS. Braski, D. N.; Early, B. F. (Oak Ridge National Lab., TN). pp 506-507 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

20256 OBSERVATIONS ON THE STRUCTURE OF Ta_2O_5. Kotval, P. S.; Dewit, C. J. (Union Carbide Research Inst., Tarrytown, NY). pp 540-541 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

20257 EFFECTS OF HIGH-ENERGY IONS ON SYNTHETIC QUARTZ. Comer, J. J. (Air Force Cambridge Research Labs., Bedford, MA). pp 544-545 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

20258 INTERFACE MICROSTRUCTURES IN BORON–ALUMINUM COMPOSITES. Hancock, J. R.; Shaw, G. G. (Midwest Research Inst., Kansas City, MO). pp 574-575 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

20259 ANNEALING OF NEUTRON-IRRADIATION-INDUCED DEFECTS IN SILICON CARBIDE. Faulkner, D.; Styles, R. C. (Atomic Energy of Canada Ltd., Whiteshell). pp 682-683 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

20260 HIGH-PRESSURE PHASE RELATIONS AND CRYSTAL GROWTH IN THE SYSTEM BORON–PHOSPHORUS–NITROGEN. Turker, E. G. Kingston, RI; Univ. of Rhode Island (1972). 97p. University Microfilms Order No. 73-2387.

Thesis (Ph.D.)

Phase transformation and crystal growth of boron nitride from a multicomponent system, boron nitride–lithium nitride–lithium hydride–lithium hydroxide, were studied up to 2000°C and between 50 to 62 kbars. P–T boundary for the stability of the hexagonal phase was experimentally determined and found to be in good agreement with theoretical calculations. The lowest temperature for the growth of cubic boron nitride crystals at 55 kbars was 1400°C. Pressure was found to effect the rate of nucleation of cubic boron nitride. Morphology of the crystals strongly depended on temperature and pressure, while large and most perfect crystals were grown in the vicinity of two-phase equilibrium lines. Crystalline boron phosphide was synthesized using high pressure–high temperature techniques. A suitable growth region for boron phosphide was determined between 10 to 20 kbars. It was found that the reaction temperature between elemental boron and phosphorus increased with increasing pressure and that the limiting temperature for the growth of boron phosphide crystals at 20 kbars is 2000°C. Boron phosphide crystals grew from a liquid phase that differs from liquid phosphorus. It was qualitatively determined that crystal size is directly proportional to the reaction time. The phase relationship between red and black phosphorus was determined in the range of 10 to 20 kbars. The red-to-black transition was found to be irreversible, which might indicate the metastability of red phosphorus at these pressures and temperatures. The effect of pressure on the melting point of black phosphorus was studied and the liquid–solid line experimentally determined. The phase relationship of B–P was primarily deter-

mined in the pseudobinary system BP–P. The system is characterized by a eutectic at about 960°C and 99% at of phosphorus. The boron phosphide liquid region is also characterized by a steep liquidus line. Extrapolation of boron phosphide liquidus above 2000°C predicts 2600°C as the melting point of boron phosphide at 20 kbars. Experimental results also indicate that 2700 ± 100°C should be the melting point of boron phosphide at 20 kbars. These results however should be interpreted cautiously. Boron phosphide and hexaboron phosphide coexist at temperatures up to 1900°C at 20 kbars with no apparent liquid phase. (Diss. Abstr. Int., B)

20261 NUCLEAR REACTOR FUEL AND FUEL ELEMENT AND PREPARATION THEREOF. Tetenbaum, M.; Hunt, P. D. (to United States Atomic Energy Commission). U. S. Patent 3,714,060. 30 Jan 1973. Filed date 12 Feb 1971. 4p.

A reactor fuel is described comprising uranium oxycarbide containing 500 to 2500 parts per million of oxygen having the empirical formula $UC_{1.00}O_{.01-.05}$. The fuel is prepared by heating single phase UC at a temperature in the range of about 2000 to 2400°K, passing helium carrier gas containing CO and CO_2 over the heated UC at a sufficiently high ratio of CO to CO_2 to prevent formation of UO_2. The oxycarbide fuel can be produced in 3- to 10-h reaction time. (Official Gazette)

20262 METHOD FOR PREPARING STABLE URANIA–PLUTONIA SOLS. Tallent, O. K. (to United States Atomic Energy Commission). U. S. Patent 3,714,056. 30 Jan 1973. Filed date 10 Jun 1971. 6p.

A method for forming static and dynamically stabilized mixed sols of plutonia and urania is described in which the plutonium and uranium are primarily in the +4 oxidation state and in which the sols are derived from solvent extraction of aqueous solutions of uranium nitrate and plutonium nitrate. The solvent extraction step comprises heating the urania sol component at a temperature and for a period of time sufficient to produce urania crystallites in the range 55 to 100 A and then extracting nitrate ions from the mixed sol until a nitrate/uranium + plutonium mole ratio of 0.08 to 0.25 is obtained. (Official Gazette)

20263 STABILIZED URANIUM OR URANIUM–PLUTONIUM NITRIDE FUEL. Leitnaker, J. M.; Spear, K. E. II. (to United States Atomic Energy Commission). U. S. Patent 3,708,433. 2 Jan 1973. Filed date 27 Aug 1970. 8p.

A nuclear fuel composition that exhibits minimal reaction with stainless steel cladding at reactor service conditions consists of a metal-containing uranium or uranium–plutonium nitride composition which forms, under reactor service conditions, a UXN_2 or $(U,Pu)XN_2$ compound as a separate stable phase where X is a metal selected from the group consisting of vanadium, chromium, and niobium. These compounds are formed by reaction of fuel with excess nitrogen as the nitrogen is produced from fuel burnup in the reactor. Thus, the nitrogen equilibrium pressure is stabilized to a value below that which will react with the stainless steel cladding. (Official Gazette)

20264 NEW PREPARATIVE PROCESSES FOR MIXED OXIDE AND ALLOY POWDERS. Dell, R. M. (Atomic Energy Research Establishment, Harwell, Eng.). pp 553-564 of Reactivity of Solids. Anderson, J. S. (ed.). London; Chapman and Hall Ltd. (1972).

From 7th International Symposium on the Reactivity of Solids; Bristol, United Kingdom of Great Britain and Northern Ireland (UK) (17 Jul 1972). See CONF-710703–.

Several novel preparative procedures for compound and mixed oxides are reviewed. Each of these processes starts from an aqueous phase which contains the metal cations in the desired proportions. Oxides of controlled particle shape and size, e.g., microspheres or fibers, are prepared by sol–gel or gel-precipitation techniques. Fine-oxide powders are formed by high-temperature spray reactions. These methods show promise also as new preparative routes for certain metal alloy powders. (auth)

20265 ENTHALPY AND HEAT CAPACITY OF BORON CARBIDE IN THE TEMPERATURE RANGE 273 TO 2600°K. Sheindlin, A. E.; Belevich, I. S.; Kozhevnikov, I. G. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 10: No. 2, 369-371(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 2, 421-423 (1972).

Analysis of experimental results shows that boron carbide is characterized by a complex dependence of specific enthalpy and specific heat capacity on temperature. The mean specific heat capacity, determined directly in the experiments, increases rapidly from room temperature up to about 1100°K and depends approximately linearly on temperature in the range 1300 to 1900°K. Above 2100°K the variation of both properties is exponential. In experiments carried out above 2650°K it was noticed that the sample lost mass and underwent a change of composition (the sample smoked and condensate formed on the cool parts of the apparatus). Melted boron carbide deposited into the calorimeter set in the form of spheres with hard surfaces and a large number of internal pores. Results of chemical analyses showed that samples heated to 2675°K contained 29.05% C_{tot} and 66.43% B, while completely fused drops of the sample contained 49.61% C_{tot} and 45.26% B. The main impurity is iron, which has obviously entered during the preparation of samples of this very hard carbide. The melting point of boron carbide measured under these conditions was 2713 ± 20°K. In some experiments the boron carbide sample was purposely allowed to come into contact with the graphite, in which case the samples melted at the lower temperature of about 2620°K. Results of chemical analyses and visual observations suggest that in the boron carbide samples near the melting point, dissociation takes place and boron vaporizes, as a result of which the solidified material is extremely porous and contains considerably less boron than the original sample. (auth)

Metals and Alloys

Refer also to abstracts 19560, 20212, and 21571.

Corrosion and Erosion

Refer also to abstracts 19447, 19853, 20235, and 20318.

20266 (AECL-4138) THERMODYNAMICS OF METAL–WATER SYSTEMS AT ELEVATED TEMPERATURES. Part 3. The Cobalt–Water System. Macdonald, D. D.; Shierman, G. R.; Butler, P. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). Dec 1972. 51p. Dep. NTIS (U.S. Sales Only). AECL $1.00.

Free energies of formation for cobalt, cobalt oxides and ionic species in solution are calculated at elevated temperatures by integrating free energy functions over the range 25°C to 300°C. These data are used to derive potential-pH relationships for the cobalt–water system and to calculate solubilities of cobalt and cobalt oxide (CoO) as a function of pH at the various temperatures considered. The potential–pH relationships predict an expanded region of corrosion in alkaline solutions at elevated temperatures. This prediction is consistent with the increased stability of the anion, $HCoO_2^-$, at higher temperatures. The solubility calculations predict that transport of Co by differential solubility occurs from the hotter to the colder regions of a non-isothermal system for $pH_{25} > 10$. At $pH_{25} = 9$ the reverse occurs. For CoO at 250°C < T < 300°C transport is predicted to occur from the hotter to the colder regions at $pH_{25} > 10$. At $pH_{25} = 9$ transport occurs in the reverse direction over the entire temperature range. (auth)

20267 INFLUENCE OF TITANIUM ON THE CORROSION RESISTANCE AND PHYSICOMECHANICAL PROPERTIES OF VANADIUM. Andreeva, V. V.; Stepanova, T. P.; Druzhinina, I. P.; Vladimirskaya, T. M. Nauch. Tr., Gos. Nauch.-Issled. Proekt. Inst. Redkometal. Prom.; 32: 175-181(1971). (In Russian).

Laboratory tests showed that Ti markedly improves the corrosion resistance of V alloys in HNO_3, while reducing resistance in H_2SO_4 and HPO_3. Alloying with Ti up to 80 to 90% raises the specific resistance and hardness of V alloys. At cathodic potentials, Ti increases the V anodic dissolution rate, but markedly reduces the rate in the anodic region. (Referativnyi Zh.)

20268 FIELD-ION-MICROSCOPE STUDIES OF VERY-LOW-COVERAGE LOW-TEMPERATURE OXYGEN ADSORPTION ON TUNGSTEN. Cranstoun, G. K. L.; Anderson, J. S. (Oxford Univ.). Surface Sci.; 32: No. 2, 397-421(Aug 1972).

The field ion microscope was used to study very-low coverage oxygen adsorption on tungsten at 78°K. Adsorbed oxygen cannot be directly observed on the surface using helium-ion imaging, but its presence may be inferred from resultant corrosion damage that occurs during the imaging process. Atom-for-atom comparison before and after an adsorption–desorption sequence allows the crystallographic position and extent of the damage to be precisely determined. Preferential damage along certain zones in the {111} and {411} regions can be correlated with the degree of unsaturation of surface metal bonds. The nature of the adsorbed species and its relationship with the adsorption site are discussed. (34 references) (auth)

20269 FIELD-ION-MICROSCOPIC INVESTIGATION OF INTERACTIONS OF METHANE WITH TUNGSTEN. Schmidt, W.; Krautz, E. (Technische Hochschule, Graz). Surface Sci.; 32: No. 2, 349-364(Aug 1972). (In German).

The imaging of methane molecules adsorbed on tungsten and the effects of methane as imaging gas are treated in detail. It is

possible to image methane molecules or dissociation products with helium as imaging gas in the field range of about 3.3 to 4.0 V/Å, with a channel plate image intensifier. The adsorption mechanism seems to be different according to the field applied beforehand. For high fields, a field adsorption has to be assumed; for low fields a dissociation of CH_4 may occur. When the field strength is increased, the dissociation products remain on the surface. Imaging of metal surfaces with methane is very difficult, because the surface is covered with an adsorption layer of CH_x, preventing a stable image with higher degree of order. In the field range of 0.8 V/Å and temperatures below 78°K, a self-promotion of methane occurs exactly on the (111) and (411) planes. Very bright areas appear on these planes, showing dynamical changes in shape and configuration. (auth)

20270 TOTAL ELECTRON IMPACT IONIZATION CROSS SECTIONS OF K SHELLS OF SURFACE ATOMS. Gerlach, R. L.; DuCharme, A. R. (Sandia Labs., Albuquerque, NM). Surface Sci.; 32: No. 2, 329-340(Aug 1972).

Measurements of total K-shell electron impact ionization cross sections of C, N, O, and Na adsorbed in single adlayers on W(100) are obtained from the Auger electron intensities. The observed cross sections are compared with the Burhop, first-Born approximation theory and with the Rudge–Schwartz, Coulomb–Born theory. The Coulomb–Born theory, which includes effects of Coulomb forces from the nucleus, agrees best with measured cross sections as a function of primary energy. Corrections due to secondary excitation are computed, showing that its relative contribution is as much as 25% for C in the energy range studied. (auth)

20271 LEED INVESTIGATION OF THE CHEMISORPTION OF NITROUS OXIDE ON A TUNGSTEN (100) SURFACE. Weinberg, W. H.; Merrill, R. P. (Univ. of California, Berkeley). Surface Sci.; 32: No. 2, 317-328(Aug 1972).

Nitrous oxide was adsorbed on the tungsten (100) surface at 295 and 500°K. Flash-desorption experiments show two binding states of nitrogen that desorb at 1005 and 1275°K. When both nitrogen states and the oxygen state from the dissociated nitrous oxide molecule are on the surface, there are no new LEED features. When the 1005°K nitrogen state is desorbed, a (4×1) LEED pattern occurs. When all the nitrogen is desorbed, a (2×1) oxide pattern remains. The oxygen is desorbed as a volatile tungsten oxide. A model of the sorbate surface, consistent with the facts currently available on the nitrous oxide–tungsten system, is described. (auth)

20272 ADSORPTION OF CARBON MONOXIDE ON TUNGSTEN (210). Adams, D. L.; Germer, L. H. (Cornell Univ., Ithaca, NY). Surface Sci.; 32: No. 1, 205-221(Jul 1972).

Thermal desorption spectra taken after adsorption of carbon monoxide at room temperature on W(210) show sequential formation with increasing coverage of strongly bound β_2 and β_1 binding states, correlated to the sequential formation of $P(2 \times 1)$ and (1×1) adsorbate structures as observed by LEED. Adsorption at room temperature gives a poorly ordered arrangement of adsorbed CO molecules, but well-ordered structures are produced by subsequent anneal. For adsorption without anneal, the work function increases monotonically with coverage to a maximum of $\Delta\phi = +0.70$ eV at saturation coverage of 1 monolayer. For adsorption followed by anneal, the work function dependence upon coverage is less simple, with even a decrease of work function at coverages less than a quarter monolayer. LEED intensity–voltage measurements from $P(2 \times 1)$–CO and $P(2 \times 1)$–N structures suggest that CO molecules occupy the sites of 4-fold symmetry upon which nitrogen is believed to be adsorbed. The distinction between the β_2 and β_1 states of adsorbed CO is attributed to heterogeneity induced by the reduction in binding energy of a CO molecule when its nearest-neighbor sites are occupied. (auth)

20273 MOLECULAR BEAM STUDY OF THE DESORPTION OF CESIUM IONS FROM TUNGSTEN CRYSTALS. Lee, T. J.; Stickney, R. E. (Massachusetts Inst. of Tech., Cambridge). Surface Sci.; 32: No. 1, 100-118(Jul 1972).

The rates of desorption of Cs^+ from W(100) and W(110) crystals were measured by the modulated molecular beam method. The Cs coverage was extremely low ($\lesssim 5 \times 10^{11}$ cm^{-2}), thereby insuring that: (a) the desorption rate of Cs atoms was negligible relative to that of Cs ions; (b) the desorption rate depended primarily on the interaction of Cs with W rather than the interaction of Cs with Cs. Assuming that the dependence of the Cs^+ desorption rate on coverage n and temperature T may be represented by the form $R^+ = n\nu^+ \exp(-\chi_0^+/kT)$, we determined ν^+ and χ_0^+ from the measured rates. For W(100) in the range 900 to 1250°K, $\nu^+ = (1.0 \pm 0.2) \times 10^{13}$ sec^{-1} and $\chi_0^+ = 2.05 \pm 0.02$ eV; for W(110) in the range 880 to 1050°K, $\nu^+ = (1.7 \pm 0.4) \times 10^{12}$ sec^{-1} and $\chi_0^+ = 1.77 \pm 0.02$ eV. The results are compared with existing experimental data and theoretical predictions. The predictions of the image potential model appear to be consistent both with the binding energies inferred from the present results and with the dipole moments inferred from previous contact-potential measurements for Cs on W(100) and W(110) crystals. (auth)

20274 ADSORPTION OF SILVER ON TUNGSTEN. Jones, J. P. (University Coll. of North Wales, Bangor). Surface Sci.; 32: No. 1, 29-44(Jul 1972).

The adsorption of silver on tungsten was studied using a simple field-emission microscope. At coverages below one monolayer, the increase in work function ϕ produced by silver can be ascribed to the formation of a silver–tungsten dipole. The decrease in ϕ at higher coverage to a value which is independent of coverage, is due to the gradual establishment of a layer which is like that of bulk silver in its electronic structure. Sub-monolayer silver diffuses over tungsten with an activation energy of 0.55 ± 0.09 eV, and thicker layers with energy ≤ 0.43 eV. The desorption energy of silver on tungsten was found to be 1.6 ± 0.1 eV by measuring rates of thermal desorption. This value does not accord with that obtained by Sugata and Takeda and is not in keeping with the theoretical predictions of Gyftopoulos and Levine. The relatively high desorption energy for silver from its own lattice (~2.6 eV at 1000°K) leads to the conclusion that multilayer silver may be desorbed most rapidly from areas of the surface at which the coverage is less than one monolayer. Field emission patterns suggest that such areas may form at {023} and {012}. Contrary to the observations of Gretz, nucleation of permanent silver crystallites occurs only when the coverage of silver is greater than eight monolayers, and current nucleation models cannot account for this behavior. (22 references) (auth)

20275 INFLUENCE OF COMPOSITION AND STRUCTURE OF MAGNESIUM–ZINC–ZIRCONIUM ALLOYS ON THEIR CORROSION AND ELECTROCHEMICAL BEHAVIOR. Timonova, M. A. pp. 136-140 of Struktura i Svoistva Legk. Splavov. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Studies conducted into (i) the influence of Zn content on the structure and corrosion behavior of Mg–Zn and Mg–Zn–Zr alloys containing $Zn \leq 20\%$ and (ii) the influence of a heat treatment leading to changes in phase composition and the form of intermetallic compound precipitation on the corrosion resistance of Mg–Zn–Zr alloys. Variation in corrosion resistance is explained by the formation of cathodic phases, with differing electrochemical behavior, and by the type of precipitates formed in the alloys. The addition of Zr to Mg–Zn alloys improves the corrosion resistance, mainly as a result of the reduction in the amount of Fe impurity in the alloy. (Metals Abstr.)

20276 CHEMISORPTION OF HYDROGEN BY THE TRANSITION METALS. Lapujoulade, J. (CEN de Saclay, Gif-sur-Yvette, France). pp 37-44 of International Congress on Hydrogen in Metals. Vols. 1 and 2. Paris; Editions Science et Industrie (1972).

From International Congress on Hydrogen in Metals Conference; Paris, France (29 May 1972). See CONF-720571–(Vols. 1 and 2).

The general concepts necessary to understand hydrogen chemisorption phenomena occurring with transition metals are recalled. Thermodynamic, kinetic, electronic, and structural considerations are discussed. The principal experimental results that have been obtained (particularly concerning the surfaces of single crystals) are discussed. Insufficient research has been conducted on these phenomena to establish a complete synthesis of the chemisorption process. (FR)

20277 STUDY OF THE ABSORPTION AND DESORPTION KINETICS OF HYDROGEN BY Ta FROM ELECTRICAL RESISTIVITY MEASUREMENTS. Garcia, E. A. (Comision Nacional de Energia Atomica, Buenos Aires). pp 238-240 of International Congress on Hydrogen in Metals. Vols. 1 and 2. Paris; Editions Science et Industrie (1972).

From International Congress on Hydrogen in Metals Conference; Paris, France (29 May 1972). See CONF-720571–(Vols. 1 and 2).

Resistivity measurements were used to study the absorption of hydrogen by Ta in the temperature and pressure range where the resistivity is proportional to the hydrogen concentration. The diffusion coefficient and the corresponding activation energy were determined. The existence of a surface barrier was demonstrated. (FR)

20278 EFFECT OF THE SURFACE BARRIER ON THE ABSORPTION KINETICS OF HYDROGEN BY Ta. Garcia, E. A. (Comision Nacional de Energia Atomica, Buenos Aires). pp 258-260 of International Congress on Hydrogen in Metals. Vols. 1 and 2. Paris; Editions Science et Industrie (1972).

From International Congress on Hydrogen in Metals Conference; Paris, France (29 May 1972). See CONF-720571-(Vols. 1 and 2).

The absorption of a gas by a metal was studied. A simple model is presented to explain the differences between the experimentally observed kinetics and those calculated from the diffusion equation. An experiment on the absorption of hydrogen by Ta is analyzed. (FR)

20279 ZIRCONIUM HYDRIDE PRECIPITATION IN ZIRCALOY-2. Ridley, N.; Caulkin, N.; Lorimer, G. W. (Univ. of Manchester, Eng.). pp 484-488 of International Congress on Hydrogen in Metals. Vols. 1 and 2. Paris; Editions Science et Industrie (1972).

From International Congress on Hydrogen in Metals Conference; Paris, France (29 May 1972). See CONF-720571-(Vols. 1 and 2).

A study was made of the precipitation of zirconium hydride in Zircaloy-2 using optical and electron microscopy. It was observed that the precipitate distribution is a sensitive function of heat-treatment procedure. Specimens water quenched from the solution treatment temperature contained a high density of individual needle-shaped fct γ hydrides of approximate length 1 μ, with relatively little grain-boundary precipitation. The intergranular needles could be seen in the electron microscope, but only the grain-boundary precipitates were resolvable in the optical microscope. With decreasing cooling rate there was an increasing tendency for the intragranular needles to form extensive arrays. The individual needles in the arrays were resolved using electron microscopy; the arrays appeared in optical micrographs as single precipitates. Although the volume fraction of intragranular γ hydride actually decreased with decreasing cooling rate, the increasing association of hydrides led to arrays that could be seen with increasing ease in the optical microscope and to the erroneous impression that the volume fraction of intragranular hydride was actually increasing with decreasing cooling rate. The increasing association of individual hydride precipitates with decreasing cooling rate was attributed to autocatalytic effects associated with a martensitic mechanism involved in the formation of the hydride. (FR)

20280 CORROSION OF ZIRCONIUM IN THE FUSED CHLORIDES OF CALCIUM, STRONTIUM, AND BARIUM. Ozeryanaya, I. N.; Tkhay, V.; Smirnov, M. V. Zashch. Metal.; 8: No. 2, 200-203(1972). (In Russian).

The reaction of Zr with the fused chlorides of Ca, Sr, and Ba at 850-to-1050°C in Ar was studied to determine the effect of cation radius on this process. Weight-loss, melt analysis, electrode potential, and anodic-polarization methods were used. The corrosion rate decreased in the sequence $CaCl_2$, $SrCl_2$, and $BaCl_2$ and for each salt it increased with the temperature. In the series NaCl-CsCl, the corrosion increase was attributed to a significant complex-formation [V. P. Volodin et al., Zashch. Metal., 3: 193 (1967)]. In the decrease in rate observed in the alkaline earth series, i.e., with increase in cation radius, complex formation must be less significant and the oxidizing capacity of the cations must be the determining factor. (Metals Abstr.)

20281 REACTIVITY OF SODIUM OXIDE IN THE SOLID STATE AND IN SOLUTION IN LIQUID SODIUM WITH SOME TRANSITION ELEMENTS. Barker, M. G.; Wood, D. J. (Univ. of Nottingham, Eng.). pp 623-629 of Reactivity of Solids. Anderson, J. S. (ed.). London; Chapman and Hall Ltd. (1972).

From 7th International Symposium on the Reactivity of Solids; Bristol, United Kingdom of Great Britain and Northern Ireland (UK) (17 Jul 1972). See CONF-720703-.

The reactivity of sodium oxide with transition metals in the solid state is compared with its reactions in solution in liquid sodium. Results are given for the reactions of niobium, tantalum, zirconium, chromium, and iron, a) with sodium containing dissolved sodium oxide; b) with solid sodium oxide under vacuum, and c) for the reactions of the oxides of these metals with sodium containing dissolved oxygen. Ternary oxide formation is observed in all these reactions and the nature of the product is related to the oxidizing power of sodium oxide. (auth)

Preparation and Fabrication

Refer also to abstracts 19588, 20264, and 21611.

20282 (LA-5111) FABRICATION AND PROPERTIES OF TUNGSTEN-60 VOL % LEAD HOLLOW CYLINDERS. Sheinberg, H.; Jones, T. I. (Los Alamos Scientific Lab., N. Mex.). Jan 1973. Contract W-7405-eng-36. 12p. Dep. NTIS $4.00.

This report documents the development of an inexpensive high-density tungsten-lead composite. Details of fabrication and testing of long, thin-walled cylinders of W-60 vol % Pb are described. It was demonstrated that a hydrostatically pressed mixture of powders yielded a product that met the high-density, low-cost, ease of fabrication, and mechanical-property goals. (auth)

20283 (RDT-C-7-5-T(1-73)) THERMOCOUPLE MATERIAL, CHROMEL-P AND ALUMEL, SOLID CONDUCTOR (BARE, FIBERGLASS-INSULATED, AND SHEATHED-OVER FIBERGLASS INSULATION). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1973. 10p. RSO.

A standard prescribing requirements for thermocouple material, chromel-P and alumel, solid conductor (bare, fiberglass-insulated, and sheathed-over fiberglass insulation) for nuclear and associated applications is presented. (JRD)

20284 (RDT-E-10-6-T(11-72)) TANK FOR GAS SERVICE. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Nov 1972. 21p. RSO.

A standard prescribing requirements for tanks for gas service for nuclear and associated applications is presented. (JRD)

20285 (RDT-M-2-3-T(1-73)) CARBON AND ALLOY STEEL WELDING FITTINGS (ASME SA-234 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1973. 10p. RSO.

A standard prescribing requirements for carbon and alloy steel welding fittings (ASME SA-234 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 2-3T, dated July 1971. (JRD)

20286 (RDT-M-3-9-T(1-73)) NICKEL-IRON-CHROMIUM ALLOY SEAMLESS PIPE AND TUBING (ASME SB-407 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1973. 9p. RSO.

A standard prescribing requirements for nickel-iron-chromium alloy seamless pipe and tubing (ASME SB-407 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 3-9T, dated Jan. 1972. (JRD)

20287 (RDT-M-3-10-T(1-73)) NICKEL-MOLYBDENUM-CHROMIUM ALLOY SEAMLESS PIPE AND TUBES (ASME SB-167 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1973. 12p. RSO.

A standard prescribing requirements for nickel-molybdenum-chromium alloy seamless pipe and tubes (ASME SB-167 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT 3-10T, dated July 1971. (JRD)

20288 (RDT-M-5-4-T(1-73)) NICKEL-CHROMIUM-IRON ALLOY PLATE, SHEET, AND STRIP (ASME SB-168 WITH ADDITIONAL REQUIREMENTS). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Jan 1973. 5p. RSO.

A standard prescribing requirements for nickel-chromium-iron alloy plate, sheet, and strip (ASME SB-168 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 5-4T, dated July 1971. (JRD)

20289 (RDT-M-8-1-T(2-73)) HELICAL AGE-HARDENABLE NICKEL-CHROMIUM-IRON ALLOY SPRINGS. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Feb 1973. 12p. RSO.

A standard prescribing requirements for helical age-hardenable nickel-chromium-iron alloy springs for nuclear and associated applications is presented. This standard supersedes M8-1T, dated Feb. 1969. (JRD)

20290 (SLA-73-23) DEPOSITION OF NIOBIUM AND NIOBIUM-CARBIDE COATINGS FROM NIOBIUM IODIDES. Repnikov, N. N.; Gorbunov, N. S. Translated from pp 307-313 Zharostoikie Teplostoikie Pokrytiya, 4th All-Union Conference, 1968. 9p. Dep. NTIS.

Results are given of investigations of the deposition of Nb and NbC coatings on graphite from niobium iodide vapor. The rate of coating deposition was studied as a function of temperature and iodine concentration. Carburization of the depositing Nb by C of the substrate occurs only above 1200°C; above 1400°C, and at low iodine vapor pressures, the coating consists of NbC alone. (DLC)

20291 PREPARATION AND PROPERTIES OF TANTALUM THIN FILMS. Baker, P. N. (Edwards High Vacuum International, Crawley, Eng.). Thin Solid Films; 14: No. 1, 3-25(1 Dec 1972).

A review is presented of investigations of methods for depositing Ta and its compounds and of the relation of deposition parameters to film properties. After an outline of how the methods differ, experimental and analytical techniques are described. A survey

is made of the published work with consideration of the different Ta phases reported. Suggestions are made for further experimental work. (82 references) (DLC)

20292 DISTRIBUTION OF IMPURITIES IN THE CRYSTALLIZATION FROM FUSED RARE EARTH ELEMENTS OF THE CERIUM SUBGROUP. Chuprikov, G. E.; Pogorelyi, A. D.; Demido, N. M. Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 4, 90-94(1972). (In Russian).

The behavior of Fe, Nd, Cu, and Ni representing typical impurities in rare earth elements was studied during recrystallization of 99.9% La and Nd as representative of the cerium subgroup. The distribution coefficients of the individual impurities at the boundary of the solid/liquid phases were measured, and the effects of the possible vaporization of some components (Ca, F, Sm) on the distribution of other components were investigated. (KSW)

20293 CRYSTALLIZATION OF INGOTS AFTER VACUUM FURNACE MELTING WITH A CONSUMABLE ELECTRODE, AND THE STABILITY OF A CAST STRUCTURE IN THE SYSTEM Nb–Ti. Baikov, A. I. Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 4, 121-127(1972). (In Russian).

Peculiarities of ingot crystallization were observed under conditions of vacuum-furnace melting with a consumable electrode. Ingots of Nb–60 at. % Ti showed a pronounced dendritic liquation that was stronger at the center of the ingot than at its periphery. The concentration micro-nonhomogeneity of the ingot was retained in wire or strip in strongly deformed states and after recrystallization annealing. Concentration nonhomogeneity in an ingot revealed the influence on the properties of the semi-finished piece. (KSW)

20294 USE OF SPUTTERED CONDUCTOR MATERIALS IN FILM INTEGRATED CIRCUITS. Lau, S. S. (Bell Telephone Labs., Inc., Allentown, PA). Thin Solid Films; 14: No. 1, 87-103(1 Dec 1972).

The properties of sputtered multilayer metal films were examined as a function of power applied during sputtering. Sputtered conductors can be used successfully as terminals (Ti/Pd/Au) for Ta_2N resistors and as counterelectrodes (NiCr/Au and NiCr/Pd/Au) for tantalum film capacitors when the proper sputter conditions are chosen. (auth)

20295 MICROSTRUCTURAL CONTROL OF Ti–6 Al–4V FORGINGS. Turnbull, G. K.; Gurganus, T. B. (Aluminum Co. of America, Cleveland). Metals Eng. Quart.; 13: No. 1, 56-60 (Feb 1973).

Microstructural control is necessary to the successful production of commercial Ti–6 Al–4 V forgings. Such control is normally directed toward refinement of the α phase through thermomechanical processing. Working within the subtransus temperature region distorts the α present at the temperature employed, with the distortion being a function of both severity of deformation and orientation of the α with relation to the working direction. Subsequent elevated subtransus temperature treatments tend to round the more highly distorted α particles, thereby producing the type of microstructure which is conducive to high mechanical properties. Since no α is present at temperatures that exceed the transus, working within this temperature region affects the β grains, and therefore aids macrostructural control more than microstructural control. Therefore, application of microstructural control through the proper selection of temperature and working cycles makes it possible to tailor the final microstructure to obtain desired mechanical property levels. (auth)

20296 ELECTROLYTIC METHOD OF PREPARATION OF IRON–NICKEL–MOLYBDENUM ALLOY POWDERS. Golubkov, L. A.; Yur'ev, B. P. (Leningrad Coke and Gas Plant). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 8, 603-607 (Aug 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 8, 1-7(Aug 1972).

A process was developed for the electrolytic preparation of three-component Fe–Ni–Mo alloy powders of varying compositions (from 0 to 15% of molybdenum with any iron-to-nickel ratio). An electrolyte was chosen that was capable of fairly stable operation and contained no organic complexing agents; the electrolyte enabled electrodeposition to be performed using several soluble and one insoluble anode, with independent regulation of the currents flowing through them. A study was made of the effect of electrolysis parameters (D_c, temperature, pH, and solution composition) on current efficiency on the cathode and on the chemical composition and structure of the deposited alloy. It was established that under certain electrolysis conditions, when the electrodeposition of all the metals is controlled by diffusional kinetics, the resultant alloy composition is determined solely by the solution composition. The optimum electrolysis conditions for the preparation of alloy powder of Permalloy composition is given. (auth)

20297 ELECTRON MICROSCOPE STUDY OF VAPOR–LIQUID–SOLID GROWTH IN In AND Sn THIN FILMS. Singh, P. H.; Murr, L. E. (Univ. of Southern California, Los Angeles). Contract AT(04-3)-113. pp 502-503 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

20298 DIFFUSION WELDING. Jacques, F. J. Tech. Mod.; 63: No. 10, 359-362(Oct 1971). (In French).

Principles of the process are described, and examples of welding with and without liquid-phase formation or with an intermediate metal are given for Al, Be, Cu, Nb, Mo, Ta, Ti, U, UO_2, Zr, and steels. (Metals Abstr.)

20299 ELECTRON BEAM WELDING AND MELTING. Transactions of the 1st International Conference, Paris, France, June 16–18, 1970. Paris; Interbus (1971). 852p. (In French and English). (CONF-700676).

Thirteen papers from a total of fifty-one abstracted for NSA concern the metallurgical problems arising in electron-beam welding (U alloys, refractories) and the applications of electron-beam welding to industry (heat exchangers) and the nuclear industry (pressure vessels). (FR)

For abstracts of individual papers see: 20300–20311, and 20377.

20300 WELDING OF URANIUM ALLOYS. Auchere, H. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France); Collot, C.; Guillaume, C.; Reisse, R.; Hocheid, B. pp 279-297 of Electron Beam Welding and Melting. Paris; Interbus (1971). (In French).

From 1st International Conference on Electron Beam Welding and Melting; Paris, France (16 Jun 1970). See CONF-700676-.

Various shaped pieces of uranium alloy were electron beam welded. Two types of alloy were studied: low additive alloys (U–1.5% Mo, U–0.2% V), and alloys containing larger quantities of additive (U–10% Mo) enabling metastable γ-phase alloys to exist at room temperature. Brittle martensitic-type structures appear in low-additive alloys because of the high cooling rate obtained in the molten zone and the neighboring zones. Preheating diminishes the brittleness of the welds obtained and is absolutely necessary for the U–1.5% Mo alloy. The effect of impurities (particularly C) on the weldability of the alloys was studied. Fissuration was observed with U–10% Mo alloys for welds effected without preheating, even though the γ phase was retained at room temperature. This phenomenon may be due to stress corrosion. (FR)

20301 MANUFACTURE OF ORIENTATED SINGLE AND DOUBLE CRYSTALS OF REFRACTORY METALS USING ZONE REFINING TECHNIQUES WITH AN ELECTRON BOMBARDMENT FURNACE. Kobylanski, A.; Goux, C. (Ecole Nationale Superieure des Mines, Saint-Etienne, France). pp 371-385 of Electron Beam Welding and Melting. Paris; Interbus (1971). (In French).

From 1st International Conference on Electron Beam Welding and Melting; Paris, France (16 Jun 1970). See CONF-700676-.

Orientated monocrystals of Nb, Mo, Ta, and W having diameters of between 4 and 7 mm were manufactured by the floating zone technique using an electron-bombardment furnace (5 kW) constructed in the laboratory. The manufacture of monocrystals of these metals necessitates the control of various parameters; electrical parameters of the heating device, purity of the metal used, size of the sample employed, focusing of the electrons emitted by the circular electron gun. A method of manufacturing orientated double crystals of Mo having a dislocation loop with a controlled amount of disorientation about a given axis was developed. This method can also be applied to other refractory metals. It consists of welding two cylindrical monocrystals together along the contact generatrix and directing the electron beam along this common generatrix. (FR)

20302 SOME METALLURGICAL INVESTIGATIONS ON ELECTRON-BEAM WELDS. Matsuda, F. (Osaka Univ.); Arata, Y.; Hashimoto, T. pp 503-528 of Electron Beam Welding and Melting. Paris; Interbus (1971).

From 1st International Conference on Electron Beam Welding and Melting; Paris, France (16 Jun 1970). See CONF-700676-.

Various tests are presented for evaluating the metallurgical quality of electron-beam welds made on the following alloys: carbon steels, weakly alloyed steels, stainless steels, aluminum and aluminum alloys, titanium and zirconium, and other nonferrous metals. The real cooling rate of a metal welded by electron beam techniques is compared to that predicted theoretically. The hardening of carbon steels or weakly alloyed steels in the 800 to 500°C temperature interval and the hardness of the welds were studied. The distribution of the temperature peaks in the electron-beam-welded joints was measured and compared with the distribution obtained in TIG welding. The refining of the metals and the gas losses or losses in additive elements from the welds are examined. Tensile tests, shock tests, and fatigue tests were carried out on the different welded zones; the different faults appearing in the welded zones (porosity, cracks, uneven penetration) were investigated. (FR)

20303 POSITION WELDING OF TUBULAR STAINLESS STEEL ASSEMBLIES. Roudier, R.; Bachelay, J.; Thome, P. (CEN de Saclay, Gif-sur-Yvette, France). pp 601-617 of Electron Beam Welding and Melting. Paris; Interbus (1971). (In French).

From 1st International Conference on Electron Beam Welding and Melting; Paris, France (16 Jun 1970). See CONF-700676-.

The following techniques were examined in view of investigating the feasibility of welding tubes on plates: cylindrical welding with tubes having horizontal axes; plane (internal) welding with tubes having vertical axes; plane (internal) welding with tubes having horizontal axes. Each of these cases leads to the use of a vented type apparatus suitable for use as a mobile workshop tool. Various applications of electron beam welding are envisaged for different reactor assemblies. (FR)

20304 APPLICATION OF ELECTRON BEAM WELDING TO THE CONSTRUCTION OF EXCHANGERS. Hennion, J. (Societe Babcock-Atlantique, Saint-Nazaire, France). pp 619-637 of Electron Beam Welding and Melting. Paris; Interbus (1971). (In French).

From 1st International Conference on Electron Beam Welding and Melting; Paris, France (16 Jun 1970). See CONF-700676-.

The construction of a prototype liquid Na heat exchanger using a special electron beam welding machine is described. The exchanger, which is made of Z 8 CNDT 18.12 stainless steel, consists of two 40-mm-thick tubular plates, 25 rectilinear tubes, a container and two fluid input and output boxes. The modules or parallel plate elements were fixed by automatic argon arc welding to both ends of each tube. These elements were then assembled in a cluster of 25 tubes by a grid-shaped series of welds performed with an electron beam. The exchanger was then constructed in the normal way. (FR)

20305 WELDING OF LARGE-DIAMETER SKIRTINGS. Roudier, R. (CEN de Saclay, Gif-sur-Yvette, France); Thome, P.; Gigarel, C. pp 695-715 of Electron Beam Welding and Melting. Paris; Interbus (1971). (In French).

From 1st International Conference on Electron Beam Welding and Melting; Paris, France (16 Jun 1970). See CONF-700676-.

Evacuated vented chamber techniques have been used successfully for the electron beam welding of 4- to 6-meter-diameter stainless steel skirtings. The most important considerations concerning this technique are the resilience at low temperatures after welding and the absence of deformations. The method was developed after preliminary mechanical and nondestructive tests and then applied to the construction of skirtings for the cryostats of the superconducting coils of the Big European Bubble Chamber (B.E.B.C. 3700). (FR)

20306 ELECTRON BEAM WELDING OF THICK SUCTION PLATES. Dumonte, P. (Sciaky, Vitry, France; Jullien, L.; Savornin, B. pp 733-752 of Electron Beam Welding and Melting. Paris; Interbus (1971). (In French).

From 1st International Conference on Electron Beam Welding and Melting; Paris, France (16 Jun 1970). See CONF-700676.

A process for the electron beam welding of the vessel of the fast neutron reactor, Phenix, is described. In view of developing this type of reactor, tests were undertaken to examine certain problems encountered when welding the roof of the vessel. This roof is made of 60-mm-thick austenitic steel (type 316L) plate and has a diameter of about 12 meters. The technology of total vacuum welding was initially developed for flanged or unflanged samples. Tests were performed with the samples juxtapositioned in different ways. In preparation for on-site welding, a prototype suction sealing type vessel working under intermediate vacuum was developed. This prototype has a separately pumped electron gun. Radiographic examination and destructive tests show encouraging results. (FR)

20307 DEVELOPMENTS IN ELECTRON BEAM WELDING TECHNIQUES. Results of Mechanical Tests on Thick Joints Made Under Industrial Conditions. Boulisset, R.; Dollet, J.; Bastien, P. (Societe des Forges et Ateliers du Creusot, Paris). pp 753-778 of Electron Beam Welding and Melting. Paris; Interbus (1971). (In French).

From 1st International Conference on Electron Beam Welding and Melting; Paris, France (16 Jun 1970). See CONF-700676-.

The welding process described is characterized by the absence of added metal and the very narrow molten zone. Welds effected in this way are compared with those made using conventional processes. The mechanical characteristics of joints welded by this process were determined, the construction of the roof of the Phenix vessel being envisaged. Austenitic Z 2 CND 18-22-2 Type steel was studied. The results of tensile tests carried out at room temperature and higher temperatures and those of resilience tests on U shaped samples are presented. The use envisaged (operating temperature of about 550°C) necessitated the determination of the creep resistance. The results obtained demonstrate that this resistance is about the same as that of the base metal. The zone around the weld and the weld itself have excellent ductilities (the same as that of the base metal). (FR)

20308 ELECTRON BEAM WELDING OF FUEL ELEMENT PLUGS AND NONDESTRUCTIVE TESTING. Diaz Diaz, J. L.; Ruiz-Bauza, J. L. (Junta de Energia Nuclear, Madrid). pp 779-802 of Electron Beam Welding and Melting. Paris; Interbus (1971). (In French).

From 1st International Conference on Electron Beam Welding and Melting; Paris, France (16 Jun 1970). See CONF-700676-.

Certain techniques for welding Mg(0.55% Zr) and Zy-2 plugs were developed. The release of Mg vapor during electron beam welding processes leads to problems which result in the automatic stopping of the installation. This difficulty was overcome by installing a chamber which retains the Mg vapors. In this way, a continuous and very deep weld is obtained. The welding conditions adopted for Zy-2 were chosen to reduce corrosion. Ultrasonic and radiography techniques were used to test the welds. An automatic immersion ultrasonic method was used. Excellent agreement was observed between the results of nondestructive and metallographic tests. (FR)

20309 ELECTRON BEAM WELDING OF MAGNESIUM–ZIRCONIUM CLAD FUEL ELEMENTS. Marquet, M. (CEN de Cadarache, Saint-Paul-les-Durance, France); Savornin, B.; Michel, Marcel pp 803-820 of Electron Beam Welding and Melting. Paris; Interbus (1971). (In French).

From 1st International Conference on Electron Beam Welding and Melting; Paris, France (16 Jun 1970). See CONF-700676-.

Electron-beam-welding techniques were used to manufacture the magnesium-clad natural-uranium fuel elements of Bugey 1, a graphite-moderated carbon-dioxide-cooled reactor. The problems encountered concern the electron-beam-welding technique (vacuum in the welding vessel, geometry of the parts to be welded) and the special properties of the cladding metal (low melting point, high thermal conductivity, and high vapor pressure). Nondestructive-testing methods can be used to check the quality of the weld and its depth. (FR)

20310 DEVELOPMENT OF NONDESTRUCTIVE TESTING METHODS FOR THE ELECTRON BEAM WELDS OF THE BUGEY NUCLEAR FUEL ELEMENTS. Destribats, M. T. (CEN de Saclay, Gif-sur Yvette, France); Picard, P.; Jullien, L.; Oquidam, B. pp 821-834 of Electron Beam Welding and Melting. Paris; Interbus (1971). (In French).

From 1st International Conference on Electron Beam Welding and Melting; Paris, France (16 Jun 1970). See CONF-700676-.

The fuel elements of the Bugey reactor consist of uranium alloy tubes clad internally and externally with a MgZr alloy. Both the internal and external claddings are finned. They are connected together at the ends of the tube by an annular MgMn plug. Electron-beam-welding techniques are used to weld the plug to the claddings. Several techniques for controlling the depth of these welds were studied and developed in view of effecting a quality control during future manufacturing processes. A weld depth indicator consisting of a circular groove (having a depth corresponding to the penetration required) in a plug was used. The amount of indicator remaining or having disappeared after the welding is effected can be detected by radiography or ultrasound. The results obtained indicate that ultrasound-control techniques enable shallow welded regions to be detected even when they are very localized and that this method of detection is much more sensitive than radiography. The establishing of this process on the industrial scale in view of manufacturing fuel elements is described. (FR)

20311 WELDING OF THIN METAL CLADDING. Cournut, B.; Marhic, J. Y.; Hocheid, B.; Rapin, M. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). pp 835-852 of Electron Beam Welding and Melting. Paris; Interbus (1971). (In French).

From 1st International Conference on Electron Beam Welding and Melting; Paris, France (16 Jun 1970). See CONF-700676-.

The most important feature normally encountered when welds are effected by electron-beam techniques is the large depth-to-width ratio of the bead. This large ratio does not occur when thin pieces are welded (a few tenths of a mm). The advantages of this welding process for the construction of thin containers and the cladding of spherical elements are discussed. In addition to the metallurgical problems inherent to the materials used, the construction of such parts imposes certain conditions: sufficiently accurate machining of the parts to be assembled and reproducibility of the welding parameters. Special nondestructive-testing techniques were developed to check the quality of the assemblies constructed. These techniques are presented. (FR)

Properties, Structure, and Phase Studies

Refer also to abstracts 19504, 20238, 20267, 20404, 21410, 21541, 21559, 21560, and 21617.

20312 (BNWL-SA-4473) SOLUBILITIES AND DIFFUSIVITIES OF HYDROGEN ISOTOPES IN NIOBIUM, NIOBIUM-ZIRCONIUM ALLOYS, AND VANADIUM AT HIGH TEMPERATURES. Charlot, L. A.; Johnson, A. B. Jr.; Westerman, R. E. (Battelle Pacific Northwest Labs., Richland, Wash.). 1972. 22p. (CONF-721111-23). Dep. NTIS.

From International Meeting on the Technology of Controlled Thermonuclear Fusion Experiments and the Engineering Aspects of Fusion Reactors; Austin, Texas, United States of America (USA) (20 Nov 1972).

Alloying elements having potentially strong interactions with hydrogen isotopes may be present in CTR first wall materials, either due to intentional alloying or because of neutron-induced transmutation. The effect of zirconium (up to 20 wt %) on the solubility and diffusivity of hydrogen and deuterium in niobium alloys was investigated at 900°C. Zirconium additions to 20% have little effect on hydrogen isotope diffusivity. Hydrogen-solubility data is presented for vanadium and niobium-1 zirconium alloy at temperatures of 800, 900, and 1000°C and pressures between 0.05 and 100 torr. Zirconium addition of 1% has negligible effect on gas solubility. A zirconium addition of 10% significantly increases gas solubility. Deuterium exhibits a lower solubility than hydrogen at equal pressures and temperatures for the alloys studied. (auth)

20313 (CEA-CONF-2118) MECHANICAL PROPERTIES OF A Cr-Mo STEEL STABILIZED WITH Nb-V. Brun, G.; Colombe, G.; Petrequin, P.; Millet, P.; Weisz, M. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires; Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). 1972. 62p. (In French). (CONF-721063-4). Dep. NTIS (U. S. Sales Only).

From Autumn Meeting on Metallurgy; Chatenay-Malabry, France (2 Oct 1972).

Ferritic steels resistant to high temperature and decarburization by Na were developed for use in the construction of Na-heated steam generators. The following steel was used: 2 ¼Cr 1Mo Nb V. The austenitizing temperatures were 1000, 1100, and 1200°C and the different cooling rates (between 800 and 500°C) were between 0.045 and 80°C/s. A single tempering treatment was used: 1 hour at 750°C. The mechanical properties determined are: tensile strength, impact resistance (Charpy V) at room temperature, and creep at 550°C. The structures of thin slices of material were examined by optical and electron microscopy. A correlation was established between the structure and the mechanical properties by controlling the austenitizing temperature, cooling rate, and tempering. Tempered acicular bainite corresponds to a good compromise between brittleness, creep resistance, and tensile strength. A desirable heat treatment was defined. The welding of metals with structures having particular properties is discussed. (France)

20314 (IKE-5-118) TOTAL EMISSION INTENSITY OF SOLID MATERIALS AT HIGH TEMPERATURES. Neuer, G. (Stuttgart Univ. (West Germany). Institut Fuer Kernenergetik). 17 Feb 1971. 108p. (In German). INIS.

Thesis.

A device was developed for measuring the total perpendicular emission intensity and the dependence on angle of emergence at temperatures between 1,000 and 3,000°K. Measurements were made according to the radiation comparison method. The radiation flux from the surface of a disk-shaped specimen is measured by means of a total radiation receiver calibrated on an especially developed black body. The specimen is heated by an electron gun, and the temperature is measured in a radial borehole by a pyrometer. Digital data acquisition results in serial measurements within a short time because the measured values are evaluated by means of a computer program. The maximum error is 3%. Graphite, Mo, Ta, and W were investigated in the form of sintered samples and as plasma-sprayed coatings. Surface influences on the emission intensity were observed. It is shown that by means of appropriate measures the total emission intensity of plasma-sprayed metals can be increased by a factor of two, as compared to polished surfaces. (INIS)

20315 (RFP-Trans-122) RESEARCH ON COBALT-BERYLLIUM ALLOYS. Venturello, G.; Burdese, A. (Bologna Univ. (Italy).; Politecnico di Torino (Italy)). Translated for Dow Chemical U. S. A., Rocky Flats Div., from Italian. (CONF-510901-1). 12p. Dep. NTIS.

A study was made of the entire binary Co-Be system, using micrography, x-ray crystallography, and thermal tests. The effects of heat treatment on the Brinell hardness of three low-Be alloys in the alpha solid solution region were determined. The lattice parameter a was found to be 2.607 Å for CoBe and 7.66 Å for Co_5Be_{21}. Micrographs are shown for Be contents from 2 to 57%. A phase diagram for the Co-Be system is presented; the melting points of CoBe and Co_5Be_{21} are 1505 and 1270°C, respectively. (DLC)

20316 (WAPD-TM-1104) RELATIONSHIP BETWEEN FAILURE STRAINS IN BURST TESTS ON ZIRCALOY TUBING AND WALL THICKNESS ECCENTRICITY. LWBR Development Program. Duncombe, E. (Bettis Atomic Power Lab., Pittsburgh, PA). Jan 1973. Contract AT(11-1)-GEN-14. 24p. Dep. NTIS.

The effects of wall thickness variation on the diametral strain reached in a pressure burst test are analyzed on the basis of two separate mechanisms, namely strain rate sensitivity and strain hardening. Simple methods of correcting the observed strain to a standard value of wall thickness variations are developed. (auth)

20317 CRYSTALLOGRAPHIC ORIENTATION OF HYDRIDE IN POLYCRYSTALLINE ZIRCALOY-2. Pegoud, J.; Guillaumin, J. (Societe Industrielle de Combustible Nucleaire, Veurey-Voroize, France). J. Nucl. Mater.; 45: No. 1, 69-72(Oct 1972). (In French).

The precipitation of hydride in a polycrystalline Zircaloy-2 alloy was studied with an electron microscope. The enrichment in hydrogen of Zircaloy-2 was obtained by aqueous corrosion in a lithium oxide solution. During corrosion in which the limit of solubility of hydrogen in Zircaloy-2 was reached, the hydride is precipitated at constant temperature and the orientations of the precipitates are not disturbed by internal stresses of thermal origin. The results are illustrated and discussed. (JSR)

20318 PHYSICOMECHANICAL AND CORROSION-ELECTROCHEMICAL PROPERTIES OF VANADIUM-NIOBIUM ALLOYS. Druzhinina, I. P.; Vladimirskaya, T. M.; Andreeva, V. V.; Stepanova, T. P.; Zagorskaya, T. A. Nauch. Tr., Gos. Nauch. Issled. Proekt. Inst. Redkometal. Prom.; 32: 160-168(1971). (In Russian).

Alloying with Nb up to 50 to 60% improves the strength, hardness, and electrical resistance of V alloys, and improves corrosion resistance in oxidizing and nonoxidizing mineral acids. Niobium acts mainly by inhibiting the anodic process of V ion transfer into the solution. (Referativnyi Zh.)

20319 MECHANICAL PROPERTIES OF SHEETS CONSISTING OF MOLYBDENUM AND MOLYBDENUM-BASE ALLOYS. Meckelburg, E. Molybdaen-Dienst; No. 81, 3-8(1972). (In German).

The results of numerous experiments carried out to explore a few mechanical and technological quality factors of nonalloyed molybdenum and of three molybdenum-base alloys are discussed. The material which was made by electric arc smelting of ingots in a vacuum oven, prepared in sheet form, was studied at temperatures lying between room temperature and 1310°C. (GF)

20320 NATURE OF THE PHASE INTERACTIONS IN MAGNESIUM ALLOYS OF THE MAGNESIUM-NEODYMIUM-YTTRIUM SYSTEM. Zvideskaya, Z. A.; Padezhnova, E. M. pp 6-10 of Struktura i Svoistva Legk. Splavov. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Microstructural and thermal analyses were used to study the alloys of four polythermal sections in the Mg-Nd-Y system with the following constant compositions; (i) Mg 80; (ii) Mg 75; (iii) Nd 4; and (iv) Y 12%: the total content of Nd + Y was ≤40%. The phases Mg_9Nd and $Mg_{24}Y_5$ are in equilibrium with the Mg-based solid solution: these phases are present in the binary Mg-Nd

and Mg–Y alloys, respectively. An invariant eutectic transformation at 536°C occurs in the Mg-rich alloys of the Mg–Nd–Y system. (Metals Abstr.)

20321 SOLUBILITY OF CERIUM AND ZIRCONIUM IN COPPER IN THE SOLID STATE. Korol'kov, A. M.; Lysova, E. V. pp 17-20 of Struktura i Svoistva Legk. Splavov. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Electrical resistance and microhardness measurements together with microstructural analyses were used to determine the separate and combined solubilities of Ce and Zr in Cu. Determinations were also made of the boundaries of the phase regions in the Cu–Ce–Zr system. At 850, 800, and 20°C the solubility of Ce in Cu in the Ce–Cu alloys is 0.10, 0.045, and 0.03 at. %, respectively, and of Zr in Cu–Zr 0.10, 0.04, and 0.015 at. %, respectively. The combined solubility of Ce and Zr in Cu at 800 and 20°C is 0.045 to 0.04 and 0.03 to 0.015 at. %, respectively. Isothermal sections at 800 and 20°C show that the phases Cu_6Ce and Cu_3Zr are in equilibrium with the ternary α solid solution. (Metals Abstr.)

20322 EFFECT OF QUENCH VACANCIES ON THE BETA-PHASE TRANSFORMATION DURING THE TEMPERING OF TITANIUM ALLOYS CONTAINING 15 TO 25% MOLYBDENUM. Novikov, I. I.; Kasparova, O. V.; Pol'kin, I. S. pp 45-48 of Struktura i Svoistva Legk. Splavov. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Various quenching regimes from the β region were used to study the breakdown kinetics of the β solution in Ti alloys containing Mo of 15, 20, and 25%. Raising the quench temperature and accelerating the cooling increased the effects of strengthening and compression during tempering in the range 300 to 500°C; this is explained by an increase in the concentration of quench vacancies. The β breakdown in the 15% Mo alloy occurs uniformly within the body of the grains, but in the 20 and 25% alloys breakdown occurs by the formation of grain margin zones that are free from α precipitates. The width of these zones decreases on raising the quench temperature and accelerating the cooling; this is associated with an increase in the concentration of quench vacancies and not with a redistribution of Mo within the body of the grains. (Metals Abstr.)

20323 CERAMIC FIBERS FOR THE REINFORCEMENT OF GAS-TURBINE BLADES. Bailey, J. E.; Barker, H. A. (Univ. of Surrey, Eng.). pp 341-359 of Ceramics in Severe Environments. Kriegel, W. W. (ed.). New York; Plenum Publishing Corp. (1971).

From Conference on Ceramics in Severe Environments; Raleigh, North Carolina, United States of America (USA) (7 Dec 1970). See CONF-701206–.

Continuous filament reinforcement of nickel base alloy turbine blades with SiC, W, or Al_2O_3 has been considered as a means of improving creep resistance at high temperatures (up to 1200°C). SiC is readily available in fiber form, but reacts chemically with the matrix; tungsten wires are excessively dense; and alumina fibers have not been available until recently. Extrusion or pulling of molten alumina was tried but abandoned at an early stage. Extrusion and sintering of a very concentrated aqueous dispersion of hydrated alumina have been moderately successful. Bend strengths of about 80×10^3 psi at 85% theoretical density are better than most commercially available sintered alumina rods of larger diameter and are capable of withstanding stresses $>10 \times 10^3$ psi for 100 h at 1100°C. Fabrication of composite blades using polycrystalline alumina (or continuous sapphire single crystal) fibers has not proved successful by liquid infiltration since severe damage is caused to the fibers. (auth)

20324 SUPERPLASTICITY OF THE TITANIUM ALLOY VTZ-1. Okhrimenko, Ya. M.; Smirnov, O. M.; Surmach, L. V.; Kuchinov, M. M. (Moscow Inst. of Steel and Steel Alloys). Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 4, 133-136(1972). (In Russian).

Temperature–rate of deformation parameters were established for the superplasticity of the two-phase Ti alloy VTZ-1 with the composition (%): 6.2 Al, 2.6 Mo, 1.9 Cr, 0.44 Fe, 0.26 Si, 0.12 C, 0.05 N, and 0.015 H. A favorable effect of H was noted, and associated with the $\alpha + \beta \rightleftharpoons \beta$ conversion (for Ti + 9% Al, about 1100°C). A positive effect of H was manifest also to a significant degree in the lowering of deformation stresses for all ranges of temperature and H concentration tested. The most favorable influence of H was observed in the range 0.15 to 0.2% by weight. (KSW)

20325 MECHANICAL PROPERTIES AND STRUCTURE OF SOME COPPER INNEROXIDIZED ALLOYS. Daneliya, E. P.; Rozenberg, V. M. Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 4, 143-150(1972). (In Russian).

The influence of oxide content on yield limits and relative elongation was studied on 0.5-mm-diameter wire samples (inner-oxidized at 950°C) of Cu–SiO_2, Cu–Al_2O_3, Cu–BeO. A preferred separation at grain boundaries occurred, resulting in brittleness of the alloys, and occasionally a reduction in strength, particularly at elevated temperatures. Inner-oxidized alloys were characterized by high stability during high-temperature treatment of previously deformed samples. A combination of cold deformation and subsequent high-temperature annealing may result in a change in the microstructure of the alloys, reduction of yield limits over a wide range of temperatures, and also to a decrease in the high-temperature brittleness. (KSW)

20326 HIGH-TEMPERATURE CREEP OF NIOBIUM AND ITS ALLOYS CONTAINING ALUMINUM OXIDE. Osipov, K. A.; Miroshkina, E. M. pp 42-48 of Legirovanie i Svoistva Zharoprochn. Splavov. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Studies were conducted into the structure and creep properties of Nb alloyed with Al_2O_3 (0.62 to 2.90%) in the 850 to 1400°C range at stresses of 3.0 to 9.5 kg/mm^2. The established creep rate of Nb can be reduced by 2 to 3 orders in these conditions by Al_2O_3 alloying. For all the alloys studied, the creep activation energy was ~56 kcal/mole, this value being independent of the applied-stress level. In certain test conditions, the creep curves for these alloys show an inverse creep section. (Metals Abstr.)

20327 CERMET ALLOY BASED ON MOLYBDENUM. Russian Patent 309,062. 15 Sep 1971. Filed date 27 Nov 1969. (In Russian).

A cermet alloy is proposed for junctions with ceramics in electrovacuum device assemblies. In order to achieve a coefficient of thermal expansion of the alloy equal to the coefficient of thermal expansion of aluminum oxide ceramic, the alloy components are taken in the following ratio: 36 to 40% Cu, 6 to 7% Ni, and the rest Mo. (JPRS)

20328 SOLUBILITY OF ZIRCONIUM AND NIOBIUM IN COPPER IN THE SOLID STATE. Rokhlin, L. L.; Bochvar, N. R.; Lysova, E. V. Izv. Vyssh. Ucheb. Zaved., Tsvet. Met.; No. 4, 114-116(1972). (In Russian).

The joint solubility of Zr and Nb in Cu in the solid state was determined at 900, 600, and 450°C. The structure of the three-component alloy contained three phases: a solid solution of Zr and Nb (α) in Cu, $ZrCu_3$, and β–Nb. A typical composition of α solid solution was (900°C) 0.05 wt % Zr + 0.08 wt % Nb. (KSW)

20329 CALORIMETRIC INVESTIGATION OF COLLECTIVE RECRYSTALLIZATION OF DILUTE COPPER ALLOYS. Arkharov, V. I.; Vangengeim, S. D.; Plastovets, V. Kh.; Serikova, V. P. (Donetsh Physical-Technical Inst., USSR). Fiz. Metal. Metalloved.; 34: No. 3, 547-552(Sep 1972). (In Russian).

The excess energy at grain boundaries released during collective recrystallization was measured in copper alloyed with Zn, Ga, Ge, Ag, Cd, In, Sn, and Sb, respectively. Two separate contributions to this energy were isolated: that caused by the release of energy during a volume decrease in the intercrystalline transition zones, and that caused by the absorption of energy due to screening by the admixed atoms. Both contributions were periodic functions of the atomic number of the added element. (tr-auth)

20330 HETERO-DIFFUSION IN THE MOLYBDENUM–TUNGSTEN SYSTEM. Korolev, A. A.; Pavlinov, L. V.; Smirnova, K. P.; Zolotukhina, O. A. Fiz. Metal. Metalloved.; 34: No. 3, 628-637(Sep 1972). (In Russian).

The temperature and concentration dependencies of the hetero-diffusion coefficient were obtained for the Mo–W system in the temperature range 1730 to 2400°C using x-ray microanalysis. The concentration dependence in this range of temperatures is described satisfactorily by an exponential function. Partial diffusion coefficients were determined in the complete range of compositions from 0 to 100% W. (tr-auth)

20331 PHASE DIAGRAM OF THE SYSTEM CERIUM–GERMANIUM. Eremenko, V. N.; Zyong Kuok Shi; Buyanov, Yu. I.; Kharkova, A. M. (Inst. of Problems of Material Studies, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 12, 1080-1084(Dec 1972). (In Ukrainian).

The complete phase diagram of the system cerium–germanium was constructed for the first time according to the results of microstructural, differential thermal, dilatometric, and x-ray phase analyses. Two compositions, Ce_4Ge_3 and Ce_3Ge, unknown before were found. Polymorphism of $CeGe_{2-x}$ ($0.36 \leq x \leq 0.43$) was investigated in a high-temperature x-ray chamber. (auth)

20332 INTERNATIONAL CONGRESS ON HYDROGEN IN METALS, PARIS, FRANCE, MAY 29, 1972. VOLUMES 1 AND 2. Paris; Editions Science et Industrie (1972). 538p. (In French and English). (CONF-720571-(Vol.1 and 2)).

Ninety four papers on hydrogen in metals were presented at the

conference. A separate abstract was prepared for each of 21 papers. (FR)

For abstracts of individual papers see: 19504, 20237, 20276–20279, 20333–20346, and 21542.

20333 ELECTROMIGRATION OF HYDROGEN ISOTOPES IN CERTAIN TRANSITION METALS. Herold, A.; Rat, J. C. (Nancy Univ.). pp 49-53 of International Congress on Hydrogen in Metals. Vols. 1 and 2. Paris; Editions Science et Industrie (1972).

From International Congress on Hydrogen in Metals Conference; Paris, France (29 May 1972). See CONF-720571–(Vol. 1 and 2).

A sensitive manometric method was employed to study the transport of hydrogen and deuterium along parallel Pd, V, Nb, and Ta wires conducting dc currents. The measurements were limited to the case of α solid solutions. The inserted hydrogen or deuterium migrates in the same direction as the current. It appears that such a migration occurs only when traces of hydrocarbon are present. All the parameters relevant to electromigration in Pd were studied: cross section of the wire, intensity of the current, gas pressure, and temperature. The mobilities calculated from the measurements were smaller than those deduced from published values of the thermal-diffusion coefficients. Only the intensity of the current and the gas pressure were considered for metals in the V column. (FR)

20334 ELECTRON CONCENTRATION CONCEPT APPLIED ON THE EFFECTS OF HYDROGEN IN METALS. Engel, N. N. (Georgia Inst. of Tech., Atlanta); Johnson, J. E. pp 60-71 of International Congress on Hydrogen in Metals. Vols. 1 and 2. Paris; Editions Science et Industrie (1972).

From International Congress on Hydrogen in Metals Conference; Paris, France (29 May 1972). See CONF-720571–(Vol. 1 and 2).

The bonding mechanism in metals and alloys can be explained by the Engel correlations, which also account for properties and phase diagrams. In the transition metals two kinds of bonds are formed. The number of outer electrons increases slowly over the entire period, whereas the number of d-electrons increases to a maximum of five in the 6 and 7 columns and then decreases to zero at column 12. Adding hydrogen to the elements will cause hydrogen to give off its electron to the metal and go into solution as a proton if the ionization potential of the metal atoms is above about 7 eV. When the ionization potential of the metal is below about 7 eV the metal will give off one electron per hydrogen atom, and the hydrogen will form negative ions under the formation of stable hydrides. This critical ionization potential is located in the middle of the transition-metal period. It is shown that the strength of the metallic bonding is increased when the number of electrons in the first half of the transition metals goes up and that the bonding is weakened in the latter half of the transition metals when electrons are added. Hydrogen addition will influence the bonds in both cases. It is shown that this bonding mechanism agrees with heats of formation, solubilities, and structures of hydrides. (FR)

20335 MOBILITY OF HYDROGEN IN TRIVALENT LANTHANIDE HYDRIDE. Viallard, R.; Dacu, J. N. (CNRS, Paris). pp 123-127 of International Congress on Hydrogen in Metals. Vols. 1 and 2. Paris; Editions Science et Industrie (1972).

From International Congress on Hydrogen in Metals Conference; Paris, France (29 May 1972). See CONF-720571–(Vol. 1 and 2).

Measurements of the resistivity and NMR were used to determine the mobility of hydrogen in the three different types of hydride normally formed between a trivalent lanthanide and hydrogen. In the α and β(H) phases, the hydrogen diffuses according to the usual mechanism encountered with interstitial solid solutions. The activation energies were determined together with the frequency factors for both the α and β(H) phases of Lu–H and La–H (or D). The place of the dihydrides among the metal hydrides is recalled. The characteristics of the Ln–H bond are discussed from results on the resistivities of eight lanthanides dihydrides. At moderate temperatures, the participation of point defects (in this case the Schottky defects in the Ln sublattice) in the intralattice diffusion can be used to explain the thermal behavior of these compounds. (FR)

20336 SOLUTE INTERACTIONS INVOLVING HYDROGEN AND THEIR INFLUENCE ON MECHANICAL BEHAVIOR OF NIOBIUM SINGLE CRYSTALS. Ulitchny, M. G.; Gibals, R. (Case Western Reserve Univ., Cleveland). pp 128-132 of International Congress on Hydrogen in Metals. Vols. 1 and 2. Paris; Editions Science et Industrie (1972).

From International Congress on Hydrogen in Metals Conference; Paris, France (29 May 1972). See CONF-720571–(Vol. 1 and 2).

The influence of hydrogen additions on the mechanical properties of single crystals of niobium and niobium-base interstitial solid solutions at low temperatures ($T \leq 0.15\ T_m$, where T_m is the melting temperature) was investigated. Hydrogen may cause strengthening (alloy hardening) or weakening (alloy softening) depending upon the purity of the niobium to which hydrogen is added. Hydrogen added to high-purity niobium causes thermally activated alloy hardening at low temperatures. On the other hand, hydrogen added to less-pure Nb or to niobium–oxygen alloys (with 100 to 900 ppM oxygen) can cause either alloy softening or precipitation (hydride) hardening. The results demonstrate that the mechanical behavior of Nb–H alloys is greatly influenced by the extent to which hydrogen can associate with other solute atoms in solution as small defect clusters. (FR)

20337 PERMEATION OF HYDROGEN THROUGH MOLYBDENUM AND TUNGSTEN AT ELEVATED TEMPERATURES. Zakharov, A. P.; Sharapov, V. M.; Babad-Zakhryapin, A. A. (Moscow Inst.,). pp 217-221 of International Congress on Hydrogen in Metals. Vols. 1 and 2. Paris; Editions Science et Industrie (1972).

From International Congress on Hydrogen in Metals Conference; Paris, France (29 May 1972). See CONF-720571–(Vol. 1 and 2).

The permeation and diffusion of hydrogen through Mo and W were investigated using high-vacuum apparatus and a mass spectrometer. A 400 to 1200°C temperature range was considered with pressures ranging between 1 and 200 torr. The difference in permeation rate for polycrystals and single crystals was established. The difference increases with increasing grain size. Comparisons of the solubility of hydrogen in Mo made from independent measurements of the permeation rate and the diffusion coefficient under equilibrium conditions suggest that the phase-boundary process strongly affects the hydrogen permeation. Experiments with samples having different thickness confirmed this hypothesis. The scheme of the penetration and the distribution of hydrogen in the metals investigated are discussed. (FR)

20338 STUDY OF THE DIFFUSION OF HYDROGEN IN TRANSITION METAL HYDRIDES AND THEIR ALLOYS. Malutchkov, O. T.; Lileeva, J. J.; Tchertkov, A. A. pp 261-263 of International Congress on Hydrogen in Metals. Vols. 1 and 2. Paris; Editions Science et Industrie (1972).

From International Congress on Hydrogen in Metals Conference; Paris, France (29 May 1972). See CONF-720571–(Vol. 1 and 2).

The relation between the activation energy and the alloy concentration with the diffusion of hydrogen in the –170 to 200°C temperature range was studied from measurements of the narrowing of the lines of the proton magnetic resonance spectra (PMR) of the hydrides of the following alloys: Ti–V, Ti–Nb, Ti–Mo. Measurements of the intensities of lines of the PMR spectra indicate that the hydrogen is redistributed between the tetrahedral and the octahedral sites of the fcc hydride lattice in relation to the concentration of the second component of the alloy and the temperature. The dependence of the hydrogen diffusion activation energy on the concentration of the second component of the alloy was demonstrated to be a linear combination of the relative changes in the lattice parameters and the effective charge of the metallic ions. (FR)

20339 EFFECT OF VARIOUS PARAMETERS ON THE EMBRITTLEMENT OF Ta IN A HYDROGEN ATMOSPHERE. Schmuk, J. (Societe Francaise des Metaux Speciaux, Venthon, France); Clauss, A. pp 443-452 of International Congress on Hydrogen in Metals. Vols. 1 and 2. Paris; Editions Science et Industrie (1972).

From International Congress on Hydrogen in Metals Conference; Paris, France (29 May 1972). See CONF-720571–(Vol. 1 and 2).

In a hydrogen atmosphere, the fracturing strain of Ta may be considerably reduced. This reduced deformability is linked to an alteration in the type of fracture occurring. The effect is increasingly pronounced with increasing interstitial oxygen or nitrogen contents and high strain rates. In order to gain a better understanding of the embrittlement process involved, the following parameters were studied: temperature during the tests; hydrogen pressure; impurities present in the hydrogen; and the isotopic hydrogen/deuterium effect. The results obtained enable certain analogies to be drawn between the phenomenon studied and the embrittlement of bcc metals containing dissolved hydrogen. (FR)

20340 LOW-TEMPERATURE EMBRITTLEMENT OF DILUTE NIOBIUM–HYDROGEN ALLOYS. Hardie, D.; McIntyre, P. (Newcastle upon Tyne Univ., Eng.). pp 453-457 of International Congress on Hydrogen in Metals. Vols. 1 and 2. Paris; Editions Science et Industrie (1972).

From International Congress on Hydrogen in Metals Conference; Paris, France (29 May 1972). See CONF-720571–(Vol. 1 and 2).

Niobium may be embrittled by the presence of a precipitated hydride. However, alloys containing hydrogen well below the solubility limit of 500 ppM at room temperature show very interesting

features when tested in tension at subambient temperatures. An alloy containing 100 ppM hydrogen shows not only a ductility minimum, such as that observed at 25 ppM hydrogen, but also a second reduction in ductility on further cooling that persists to 77°K. This second embrittlement is clearly shown to be associated with the martensitic precipitation of a niobium hydride, whereas the earlier minimum is due to the multiple cracking ensuing from stress-induced segregation of hydrogen and is very dependent on strain rate (i.e., diffusion). At the lower hydrogen concentration, no precipitation of hydride occurs above 77°K and there is, therefore, merely a strain-rate-dependent ductility minimum depending on diffusion of hydrogen to particular sites for crack nucleation. (FR)

20341 EFFECTS OF HYDROGEN IN URANIUM. Hughes, A. N.; Orman, S.; Picton, G. pp 466-468 of International Congress on Hydrogen in Metals. Vols. 1 and 2. Paris; Editions Science et Industrie (1972).

From International Congress on Hydrogen in Metals Conference; Paris, France (29 May 1972). See CONF-720571-(Vol. 1 and 2).

Several sources of hydrogen contamination of uranium are described—from salt-bath heating to corrosion of nickel-plated uranium. To evaluate the effects of such contamination on the tensile properties of uranium, additions of up to 20-ppM hydrogen were made by a thermal charging method, which gives accurate control of the hydrogen added and ensures a reproducible uranium structure. Tests show that the loss of strength and ductility of uranium containing hydrogen is dependent on the test environment and test temperature, the effects being eliminated at 100°C. It is concluded that the effects observed are due to a weakening of grain-boundary cohesion, although no preferential precipitation of uranium hydride was observed at grain boundaries. (FR)

20342 GRAIN-BOUNDARY HYDRIDE PRECIPITATES IN ZIRCALOY-2. Mishima, Y.; Ishino, S.; Kawanishi, H. (Tokyo Univ.). pp 469-473 of International Congress on Hydrogen in Metals. Vols. 1 and 2. Paris; Editions Science et Industrie (1972).

From International Congress on Hydrogen in Metals Conference; Paris, France (29 May 1972). See CONF-720571-(Vol. 1 and 2).

In order to elucidate to so-called directionality problems in hydrides, several experimental investigations were carried out. The properties of the grain boundary are considered to be important in the precipitation of the hydride. The relative orientation of the grains in both sides of the grain boundary was examined using Knoop-hardness measurements. The properties of the boundaries on which the hydrides precipitated were determined. The stress reorientation of the hydrides precipitated at grain boundaries was also examined. A model is proposed to qualitatively explain the directional precipitation of hydrides on the grain boundary. (FR)

20343 RELATIVE AMOUNTS AND ORIENTATION OF INTERGRANULAR AND INTRAGRANULAR HYDRIDE IN ANNEALED ZIRCALOY. Ambler, J. F. R. (Atomic Energy of Canada Ltd., Chalk River, Ont.); Olson, P. G. pp 474-479 of International Congress on Hydrogen in Metals. Vols. 1 and 2. Paris; Editions Science et Industrie (1972).

From International Congress on Hydrogen in Metals Conference; Paris, France (29 May 1972). See CONF-720571-(Vol. 1 and 2).

The effects of total hydrogen concentration, grain size, and texture on the relative amounts and orientation of intergranular and intragranular hydrides in six batches of annealed Zircaloy tubing were investigated. The fraction of intergranular hydride was independent of texture and grain size, but decreased sharply with increase in hydrogen concentration up to approximately 200 ppM; above this concentration the fraction was constant. The orientation of the intragranular hydride was markedly dependent upon the hydrogen concentration, while that of the intergranular hydride was independent of hydrogen concentration. (FR)

20344 HIGH-SPEED DEFORMATION METHOD FOR TESTING THE DEFORMABILITY OF ZIRCALOY-2. Fratus, G.; Montagnani, M.; Quirino, I. (Commission of the European Communities, Ispra, Italy). pp 480-483 of International Congress on Hydrogen in Metals. Vols. 1 and 2. Paris; Editions Science et Industrie (1972).

From International Congress on Hydrogen in Metals Conference; Paris, France (29 May 1972). See CONF-720571-(Vol. 1 and 2).

The hydrogenation of annuli (having diameters of about 100 mm) of Zircaloy-2 was effected using an electrolytic method. Concentrations of 120, 220, and 500 ppM of H_2 were obtained. The deformabilities were studied at different temperatures by detonating an explosive charge positioned at the center of the annulus. The relative elongations were measured along the three axes as a function of the hydrogenation and the temperature (up to 300°C). The elongation/hydrogenation temperature curves have shapes similar to those observed in IZOD tests. However, in the method presented, the effect of the transition temperature on the curves obtained is considerably less significant. Tests are currently being carried out in order to exactly measure the energy absorbed during the explosion tests, a fast camera being used. In addition, metallographic tests of the fracture zone are currently being conducted in order to obtain a better understanding of the mechanism involved. (FR)

20345 SOME OBSERVATIONS ON THE DISSOLUTION AND PRECIPITATION OF ZIRCONIUM HYDRIDES IN α-ZIRCONIUM BY ELECTRON MICROSCOPY. Mishima, Y.; Ishino, S.; Kawnishi, H. (Tokyo Univ.). pp 489-496 of International Congress on Hydrogen in Metals. Vols. 1 and 2. Paris; Editions Science et Industrie (1972).

From International Congress on Hydrogen in Metals Conference; Paris, France (29 May 1972). See CONF-720571-(Vol. 1 and 2).

Transmission electron-microscopy was used to study the dissolution and precipitation of zirconium hydrides in α zirconium. In-situ electron beam heating techniques were used i.e., removing or inserting the electron-microscope aperture to heat or cool the specimen. Fine hydride precipitates were observed to exhibit dissolution and precipitation. Two kinds of fringe contrast systems were observed after rapid cooling: a system having fringes parallel to the ⟨1120⟩ direction formed at the interface between the matrix and the precipitates (these fringes were analyzed under high magnification and found to be ⟨1012⟩ micro twins); and a system in which the fringe contrast is either parallel or perpendicular to the ⟨1120⟩ direction (possibly due to planar segregation of hydrogen atoms during cooling). The effects on the fine precipitates of an applied tensile stress were also investigated. (FR)

20346 IMPORTANCE OF THE MATRIX IN HYDRIDE EMBRITTLEMENT OF ZIRCONIUM. Hardie, D. (Newcastle upon Tyne Univ., Eng.). pp 497-500 of International Congress on Hydrogen in Metals. Vols. 1 and 2. Paris; Editions Science et Industrie (1972).

From International Congress on Hydrogen in Metals Conference; Paris, France (29 May 1972). See CONF-720571-(Vol.1 and 2).

The fracture of brittle hydride, precipitated from hydrided zirconium during slow cooling, may result in porosity because of subsequent plastic deformation of the surrounding ductile matrix or initiation of unstable low-strain fracture. The transition from low-strain (low-energy) fracture to more ductile behavior is sensitive to strain rate in bending but certainly not restricted to impact tests. Whether or not unstable propagation occurs appears to depend very much on the properties of the matrix and its resistance to the passage of a crack from one brittle hydride to the next; important factors are hydride spacing and hydride orientation, both of which control the distance traveled through what is an inherently ductile matrix. Slow-bend testing of a range of different materials, hydrided to various levels up to 1000 ppM, indicates that the transition temperature at a particular hydrogen content depends principally on the plastic properties of the matrix and corresponds to the temperature at which the material has a particular flow stress in the vacuum-annealed condition. (France)

20347 ALUMINUM ALLOY. Bewley, H. D. (to United States Atomic Energy Commission). U. S. Patent 3,698,890. 17 Oct 1972. Filed 9 Dec 1971.

A castable, age-hardenable, aluminum-base alloy is described consisting essentially of, in weight percent, 3.0 to 4.5 magnesium, 0.6 to 1.8 silicon, 0.4 to 1.5 silver zirconium at a concentration effective to impart increased fatigue strength to the resultant alloy. (Official Gazette)

20348 MEASURING ELECTRICAL RESISTIVITY TO 4000°F. Valentich, J. (Westinghouse Electric Corp., Pittsburgh). Metals Eng. Quart.; 13: No. 1, 11-13(Feb 1973).

Subsized specimens (1 in. long by $\frac{1}{4}$ in. in diameter) fitted with thermocouple and electrical lead wires can demonstrate the resistivity of a metal within ±2%. (auth)

20349 SINTERED V2Zh-TYPE ALLOY. Antsiferov, V. N.; Bobrova, S. N. (Perm Engineering Inst., USSR). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 8, 619-621(Aug 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 8, 21-24(Aug 1972).

An iron-base alloy of the V2Zh-type containing 2.2% C, 0.4 to 0.7% Si, 18% Cr, and 16% Mo was produced by powder metallurgy. The alloy has a homogeneous fine-grained microstructure, whose constituents are superior in microhardness to the phases of V2Zh cast alloy. The optimum conditions for the manufacture and heat treatment of the alloy were determined. (JRD)

20350 ROLE OF DISPERSION HARDENING IN THE EMBRITTLEMENT OF NICKEL-BASE ALLOYS DURING THE PRODUC-

TION OF COLD-FORMED TUBE. Alferova, N. S.; Rizol, A. I.; Lagosha, A. V. pp 124-129 of Legirovanie i Svoistva Zharoprochn. Splavov. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

The principal factors that are responsible for the fracture of cold-formed tubes, made from aging Ni-base alloys, during annealing treatments are discussed. The aging plays an important role in this process since the fracture occurs in the temperature range of intensive aging. Residual stresses are also of importance. Fracture occurs with tubes of EI827 [Cr 9 to 11, Al 4.0 to 4.6, W 4.5 to 5.5, Mo 5.0 to 6.5, B 0.01 to 0.02, Ce 0.01, Fe < 5.0, V 0.7%] and EI437B [Nimonic 80A] which, after deformation, possess significant residual tensile stresses. When rolled with small, i.e., 8 to 10% wall reductions, they clearly show deformation heterogeneity. Increasing the degree of deformation during rolling provides a more uniform deformation, more uniform aging, and an effective absence of residual stresses which, taken together, prevent the tendency of rolled tubes to fracture. The main cause for fracture of tubes during heat treatment is the localization of aging under conditions in which the alloy has less opportunity to relax and when first order residual stresses are present. Measures are described for eliminating the tendency of these alloys to fracture during annealing. (Metals Abstr.)

20351 BORATING OF ALLOYS IN TECHNICAL BORON CARBIDE. Trush, I. Kh.; Permyakov, V. G.; Loskutov, V. F.; Pisarenko, V. N. (Kiev Polytechnic Inst.). Tekhnol. Organ. Proizvod.; No. 2, 51-52(Mar 1972). (In Russian).

The kinetics of boriding, the phase composition, and the hardness of diffuse layers of alloys of technical boron carbide were studied after Cr, W, Nb, Zr, V or Ti had been added. Many of the experiments were conducted on using a base of Armco iron and pure metal. Boriding of all samples (with different amounts of alloying elements) was conducted at 950°C in a IKI9H9T steel crucible. After boriding, samples were studied with respect to microstructure and hardness. Curves were constructed which show the dependence of boride layer depth on the content of the alloying elements. An increase in the content of alloying elements in the melt lead to a decrease in the depth of the borided layer. The alloying elements, arranged in the order in which they reduced the depth of the borided layer, are Cr, W, Nb, Ti, V, and Zr. (tr-INIS)

20352 OBSERVATION OF FACE CENTERED CUBIC Gd, Tb, Dy, Ho, Er, AND Tm IN THE FORM OF THIN FILMS AND THEIR OXIDATION. Curzon, A. E.; Chlebek, H. G. (Simon Fraser Univ., Burnaby, B. C.). J. Phys., F (London); 3: No. 1, 1-5(Jan 1973).

High-energy transmission electron diffraction and microscope studies were made of vapor-deposited Gd, Tb, Dy, Ho, Er, and Tm films. The thinnest films had face centered cubic structures, whereas in the thicker films the hexagonal close packed structures of the metals in bulk form were observed. Oxidation of the films was observed in the vacuum in which they were deposited and also under the influence of the electron beam of the electron microscope. The lattice parameters of the face centered cubic forms of Gd, Tb, Dy, Ho, Er, and Tm were found respectively to be 5.40, 5.20, 5.18, 5.15, 5.09 and 5.06 Å the error being about ±1%. (auth)

20353 THEORY OF ALLOYING MAGNESIUM BY RARE-EARTH METALS AND YTTRIUM. Tikhova, N. M.; Solov'eva, G. G.; Blokhina, V. A.; Antipova, A. P.; Vasil'eva, T. P. pp 99-103 of Redkozemel'n. Met. i Splavy. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Explanations for the beneficial action of rare-earth metals, and Y, on the creep resistance of Mg compared with Mg–Al alloys are examined. Photomicrographs are presented for a variety of compositions and heat treatments. The mechanical properties of existing alloys are listed as well as those of an experimental Y-containing alloy. (Metals Abstr.)

20354 EFFECTS OF RARE-EARTH METALS ON THE PROPERTIES OF VANADIUM, NIOBIUM, MOLYBDENUM, AND THEIR ALLOYS. Savitskii, E. M. pp 81-88 of Redkozemel'n. Met. i Splavy. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Studies were made of the interaction of rare-earth metals with V, Mo, and Nb. These systems show immiscibility in the liquid state, a lack of chemical compound formation and an insignificant solubility of the components. Rare-earth metals are prospective deoxidizers for V, Mo, and Nb and alloys based on them. They possess the additional advantages of removing N and S, showing modification and alloying effects, and causing a redistribution of nonmetallic inclusions as well as changing their chemical composition. Methods were developed for the use of rare-earth metals for refining V and Mo from interstitial impurities and also for making a series of new Nb- (and V-) based superconducting alloys. (20 references). (Metals Abstr.)

20355 SAMARIUM AND EUROPIUM ALLOYS. Torchinova, R. S.; Terekhova, V. F.; Savitskii, E. M. pp 34-41 of Redkozemel'n. Met. i Splavy. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Data are given for the physico-chemical interactions of Sm and Eu with Ni, Fe, Gd, and Ce and the binary phase diagrams for these systems are introduced. The possible nature of these reactions, and diagrams for systems not yet studied, are considered. Prospects for the use of Sm alloys as permanent magnets are examined. (20 references). (Metals Abstr.)

20356 HIGH-TEMPERATURE THERMOMECHANICAL TREATMENT OF MAGNESIUM–NEODYMIUM ALLOYS. Drits, M. E.; Sviderskaya, Z. A.; Oreshkina, A. A. pp 127-136 of Struktura i Svoistva Legk. Splavov. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Experimental studies, involving metallography and resistivity and x-ray methods, were conducted into the influence of high temperature mechanical treatment on the mechanical properties and structure of the Mg–Nd alloys MA11 (Mg–Nd–Mn–Ni) and MA12 (Mg–Nd–Zr). For an 87% deformation, the optimum treatment for MA11 is to heat the billets to 490°C for 2 h, cool, and deform at 350°C. For MA12 the corresponding values are 530°C for 2h and deform at 300°C. Comparison of these techniques with those currently used, i.e., quenching and aging, shows a marked improvement with respect to the room-temperature mechanical properties, and also in PS at 250°C; the elongation is also higher than after the low-temperature mechanical treatment. The strengthening during the high-temperature process is associated with distortion of the lattice of the Mg-rich solid solution and also with changes in the degrees of relaxation, recrystallization, and decomposition in the supersaturated solid solution. (Metals Abstr.)

20357 RARE-EARTH METALS, THEIR ALLOYS, AND NEW APPLICATIONS. Terekhova, V. F. pp 17-21 of Redkozemel'n. Met. i Splavy. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Rare-earth-metal single crystals, their structure, and phase diagrams with Fe, Hf, V, and Ca are reviewed. Analysis of the phase diagrams leads to the conclusion that the simpler diagrams (continuous solid solutions and eutectics) are formed only with a small number of elements, namely with those of Groups III and IVA of the periodic system. As a rule, eutectic systems form from metals of the Y subgroup and IVA group metals, the Ce subgroup showing a wide region of immiscibility with these metals. Chemical compounds form from rare-earth metals and Group I and VIII metals. (Metals Abstr.)

20358 SINTERED 13% Cr STEEL FOR FAST REACTOR FUEL ELEMENT CANS. I. TiO_2-FREE STEELS. Denisenko, E. T.; van Asbroeck, P. (Inst. of Materials Science, Kiev). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 8, 673-683(Aug 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 8, 89-102(Aug 1972).

A study was made of the effects of various metallurgical factors on the structure and strength and creep characteristics of sintered 13% Cr ferritic steel. The beneficial effect of alloying with molybdenum on these properties is noted and discussed, and the influence exerted by various plastic working conditions is examined. Data yielded by determination of various properties of sintered ferritic steels show that the changes observed are attributable to differences in internal oxidation, diffusion, and carbide formation processes, which play an important part in the evolution and variation of properties during the production of the steels and prolonged testing under load. While internal oxidation and diffusion are of importance from the viewpoint of stability of properties in the initial condition, carbide formation is responsible for embrittlement during creep. Two metallurgical methods may be recommended for preventing this type of brittleness: 1) lowering carbon content of starting powders and finished steels, 2) adding elements having a greater affinity for carbon. In the light of the investigation that has been carried out, it may be assumed that titanium combines with the carbon in steel, thereby stabilizing the latter's ductility for some thousands of hours. At the same time, the steel matrix is additionally strengthened by precipitated intermetallic phases. However, the required stress-rupture characteristics and creep resistance, comparable with those exhibited by certain austenitic stainless steels, cannot, of course, be achieved by alloying alone. To obtain an even greater strengthening effect, a dispersed oxide phase must be introduced into these ferritic steels. (auth)

20359 ELECTROMAGNETIC DETECTION OF ACOUSTIC EMISSION FROM A MARTENSITIC TRANSFORMATION. Maxfield, B. W.; Cochran, R. (Cornell Univ., Ithaca, NY). Contract AT(11-1)-3150. Mater. Eval.; 31: No. 2, 17-20(Feb 1973). (COO-3150-1).

The acoustic emission resulting from the martensitic phase transformation in a gold–47.5 at. % cadmium alloy was observed using a purely electromagnetic means to detect the acoustic signals. This detection method eliminates transducer-related resonances which usually make a determination of the frequency spectrum associated with acoustic emission very difficult. Both the temporal and frequency response of individual acoustic emission events were determined. For the small specimen used in this investigation, the frequency response is dominated by acoustic cavity resonance effects in the specimen. This work shows that electromagnetic detection of acoustic emission may be especially useful when attempting to determine the frequency spectrum of various sources of acoustic emission. (auth)

20360 MARMEM EFFECT IN β' AgCd ALLOYS. Tong, H. C.; Wayman, C. M. (Univ. of Illinois, Urbana). Scr. Met.; 7: No. 2, 215-221(Feb 1973).

The martensitic phase exhibiting the shape memory phenomenon is termed the "marmem" effect. An investigation was conducted on the thermoelastic nature of the martensite, the marmem effect, and its relation to the M_s, M_f, A_s, and A_f temperatures for AgCd alloys of composition 43 to 49 at.% Cd. It was found that the shape recovery began at A_s and was complete at A_f, and that the shape recovery process is associated with the martensite → parent transformation. (DLC)

20361 RELAXATION PROCESSES IN METASTABLE BETA-TITANIUM ALLOYS. Sommer, A. W. (North American Rockwell Corp., Los Angeles); Motokura, S.; Ono, K.; Buck, O. Acta Met.; 21: No. 4, 489-497(Apr 1973).

Extensive observations were made on an internal friction peak in a series of binary titanium alloys containing Mo and V. The compositions of the alloys ranged from 8 to 16 at.% Mo and from 15 to 50 at.% V, respectively. The peak was observed depending on alloy compositions in temperature ranges of 120 to 140°K at 10^4 Hz and 153 to 210°K at 10^7 Hz, respectively. In both alloy systems, the peak strength passed through a maximum with increasing alloy content at or near the upper compositional bound for athermal omega formation. The peak persisted well beyond the composition associated with the peak strength maximum, although its strength was greatly diminished. The peak structure was not disturbed by 15% room-temperature plastic deformation. The peak strength was severely reduced by annealing in the temperature range of thermal omega precipitation. Activation parameters of $Q = 0.2$ eV and $\tau_0 = 2 \times 10^{-14}$ sec were observed for both Ti–10 Mo and Ti–20 V. Results are compared to the properties of a similar internal friction peak reported earlier in Ti and Zr base alloys, and discussed in conjunction with a reciprocal lattice streaking phenomenon also known to occur in these metastable beta titanium alloys. It is suggested that the atomistic mechanism responsible for the internal friction peak is the same "atom shuffle" process proposed by de Fontaine, Paton, and Williams to explain reciprocal lattice streaking. Limited observations on a lower temperature relaxation ($T \leq 25$°K at 10^4 Hz) in the Ti–N alloy system are also reported. (auth)

20362 EFFECT OF HEAT TREATMENT ON MECHANICAL PROPERTIES OF SUPERCONDUCTING ALLOY 65BT. Leskov, B. A.; Matorin, V. I. Sb. Tr. Tsent. Nauch.-Issled. Inst. Chern. Met.; No. 78, 242-250(1971). (In Russian).

Five different heat treatments were applied to the superconducting alloy 65BT [65 Nb, Zr 2 to 11%, balance Ti] to explain the influence of heat treatment on the workability of this alloy. Hot-rolled specimens were: (i) annealed for 2 h at 1100°C and furnace cooled, (ii) annealed for 2 h at 1100°C and water quenched, (iii) quenched from 1100°C and tempered for 30 min at 580°C, (iv) quenched from 1100°C and tempered for 120 min at 580°C, and (v) tempered at 580°C for 30 min. Treatment (i) and quenching treatments raise the elongation and reduction in area values and reduce the YS. Stress/strain curves for quenched and slowly cooled specimens differ only with respect to elongation, which is approx. halved by slow cooling. The value of the YS was practically independent of the cooling rate after annealing at 1100°C. (Referativnyi Zh.)

20363 EMF STUDY OF THE HIGH-TEMPERATURE THERMODYNAMIC PROPERTIES OF SOLID TANTALUM–MOLYBDENUM ALLOYS. Singhal, S. C.; Worrell, W. L. (Univ. of Pennsylvania, Philadelphia). pp 65-74 of Metallurgical Chemistry. Kubaschewski, O. (ed.). London; Her Majesty's Stationery Office (1972).

From International symposium on metallurgical chemistry; London, UK (14 Jul 1971). See CONF 710738–.

The thermodynamic properties of solid tantalum–molybdenum alloys were determined between 1000 and 1300°K using a galvanic cell with a thoria-based electrolyte. The activities of tantalum and molybdenum exhibit large negative deviations from ideality. The enthalpies of solution are large and negative. The observed small negative excess entropies of solution may be due to a negative vibrational entropy and/or the presence of short range order. (auth)

20364 DEPOSITION OF TITANIUM–ZIRCONIUM ALLOYS BY THE IODIDE PROCESS. Shelton, R. A. J. (Univ. of Manchester, Eng.); Holt, G. pp 559-566 of Metallurgical Chemistry. Kubaschewski, O. (ed.). London; Her Majesty's Stationery Office (1972).

From International symposium on metallurgical chemistry; London, UK (14 Jul 1971). See CONF 710738–.

The apparatus and experimental technique was similar to that used to study the deposition of copper (Trans. Faraday Soc., 62: 222(1966)). Titanium and zirconium metal-sponge granules of a similar size range were mixed well together and placed in the deposition apparatus, being supported by means of a molybdenum gauze cylinder, concentric with the filament. After evacuation, out-gassing and sealing, iodine was introduced and the tetra-iodides were formed immediately. These were allowed to come to equilibrium with the sponge metals at the required ambient temperature to give the tri-iodides. Alloy deposition then took place on heating the filament at a constant temperature of 1300°C. The composition of these alloys is shown as a function of the ambient temperature. Traces made across selected cross sections of specimens with the microprobe analyzer showed them to be uniform in composition. (DLC)

20365 SYSTEM Co–(Zr,Nb)Co_2. Bataleva, S. K.; Kuprina, V. V.; Ronami, G. N.; Kuznetsova, S. M. Vestn. Mosk. Univ., Ser. II. Khim.; 13: No. 6, 667-671(1972). (In Russian).

The compounds Zr_2Co_{11} and Zr_6Co_{23} were found in equilibrium under certain conditions. The double compounds $NbCo_2$ and $ZrCo_2$ formed a continuous series of solid solutions. Confirmation was obtained by x-ray spectra and microscopic analysis. (KSW)

20366 CALCULATION OF THE HEATS OF MIXING OF BINARY LIQUID ALLOYS. Kononenko, V. I.; Yatsenko, S. P. (Inst. of Chemistry, Sverdlovsk, USSR). Russ. J. Phys. Chem. (Engl. Transl.); 46: No. 7, 994-996(Jul 1972).

Translated from Zh. Fiz. Khim.; 46: No. 7, 1732-1736(Jul 1972).

The proposed method of calculating heats of mixing was tested on systems of different types: eutectic (Ga–In, In–Sn), monotectic (Ga–Bi), and systems with compound formation (Hg–In). The agreement between calculated and experimental values of the heat of mixing shows that the assumptions made in the calculation are justified. (auth)

20367 EFFECT OF RARE-EARTH METALS ON THE STRUCTURE AND PROPERTIES OF IRON–CARBON ALLOYS. Belai, G. E.; Lev, I. E.; Yatsenko, A. I.; Gerasimova, T. I. pp 115-116 of Redkozemel'n. Met. i Splavy. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Results are given of an examination of the inter-phase distribution of rare-earth metals and of the mechanism of their effect on the solidification of cast irons. During eutectic solidification, rare-earth metals lower the activity of C and impede the nucleation and growth of solid phases; these effects result in significant supercooling. An increase in the rare-earth metal content hinders the formation of graphite, thus allowing growth of a carbide–γ eutectic in preference to that of the graphite–γ eutectic. (Metals Abstr.)

20368 CHEMICAL HETEROGENEITY OF REFRACTORY METALS AND ALLOYS. Gruzin, P. L.; Zemskii, S. V. pp 194-198 of Legirovanie i Svoistva Zharoprochn. Splavov. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Radioisotope methods and gamma-resonance techniques are described for the study of the macro-, micro-, and submicroheterogeneity in refractory metals. Data are given for the distribution of (i) C impurity at the <0.02% level in Ti, Zr, Nb, and Cr, (ii) C in unalloyed Mo after its crystallization from the liquid state, after hot deformation, and after various heat treatments, (iii) C in Mo-containing B impurity after similar treatments, (iv) Zr in Mo, (v) C in W, and (vi) C in Mo–Cr welded joints. These elements concentrate at grain boundaries except for Zr. Heterogeneity of C distribution is to a large extent associated with that of the distribution of lattice defects. In the system (vi) movement of C from Mo to Cr occurs on heating, the C then being distributed at the Cr grain boundaries. The effect of the heterogeneity and diffusion mobility of refractory metals on creep resistance is discussed. (Metals Abstr.)

20369 SCANDIUM ALLOYS AND THEIR TECHNICAL USES. Naumkin, O. P.; Terekhova, V. F.; Savitskii, E. M. pp 23-34 of Redkozemel'n. Met. i Splavy. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Data are provided on the phase diagrams and properties of alloys of Sc with Cu, La, V, Nb, Cr, and Fe. Comparison with similar data from other rare earths indicates that Sc differs significantly from these, as a result of differing electronic structure, electronegativity, and atomic radius. Such studies, together with data on the properties of pure Sc, are used to show possible industrial applications. (Metals Abstr.)

20370 HETERO-EPITAXY OF GROUP Va METALS ON SAPPHIRE. O'Neal, J. E.; Bellina, J. J. Jr.; Rath, B. B. (McDonnell Douglas Research Labs., St. Louis). pp 492-493 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

20371 STRUCTURE OF Co-Cu-Ce PERMANENT MAGNET ALLOYS. Leamy, H. J.; Green, M. L. (Bell Telephone Labs., Murray Hill, NJ). pp 498-499 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

20372 HARDENING EFFECT AND ELECTRON METALLOGRAPHY OF PRECIPITATION IN URANIUM WITH SMALL ADDITIONS OF TITANIUM. Johnson, D. H.; Ammons, A. M. (Oak Ridge Y-12 Plant, TN). pp 580-581 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

20373 PHASE TRANSFORMATION IN Ti-6Al-4V ALLOYS. Fujishiro, S. (Materials Lab., Wright-Patterson AFB, Dayton, OH). pp 586-587 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

20374 MORPHOLOGY OF γ PRECIPITATES IN Ni-RICH γ'-$Ni_3(Al,Ta)$. Kear, B. H.; Doherty, J. E.; Giamei, A. F.; Lemaire, L. P. (Pratt and Whitney Aircraft, Middletown, CT). pp 588-589 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

20375 SOLID-CADMIUM-INDUCED CRACKING OF Ti-6Al-4V ALLOY. Meyn, D. A. (Naval Research Lab., Washington, DC). pp 668-669 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

20376 WORK HARDENING OF PURE AND NITROGEN-DOPED TANTALUM CRYSTALS. Lachenmann, R.; Schultz, H. (Max-Planck Institut fuer Metallforschung, Stuttgart). Scr. Met.; 7: No. 2, 155-160(Feb 1973).

Pure Ta single crystals oriented for single slip were prepared and doped with 97 to 326 at. % ppM of N. Tensile tests were carried out at 473°K and a strain rate of 5.5×10^{-5} sec^{-1}. The high-purity Ta shows a 3-stage hardening stress-strain curve, whereas that for the N-doped Ta approaches the parabolic. The maximum hardening rate at the inflection point between stages I and III for pure Ta is comparable with that observed in fcc metals. N-doping increases the critical resolved shear stress and work hardening rate in stage I and reduces the maximum hardening rate at the inflection point. (DLC)

20377 MECHANICAL TESTS FOR WELDED ZONES AND WELDING BEADS. Poirier, J.; Fidelle, J. P.; Roux, C. (Centre d'Etudes de Bruyeres-le-Chatel, Montrouge, France). pp 529-543 of Electron Beam Welding and Melting. Paris; Interbus (1971).

From 1st International Conference on Electron Beam Welding and Melting; Paris, France (16 Jun 1970). See CONF-700676-.

A simple and rapid test for studying the plasticity of welded zones is described. A disk is mounted in the wall of a tank containing a compressed inert gas (1500 bars). A continually increasing pressure is applied until the disk breaks. The plasticity of the test piece is estimated from the value of the gas pressure required to rupture the disk. The effect of the external hydrogen gas pressure on the weld may be studied using a 1500-bar-pressure hydrogen bottle as the pressure source. A test was performed with a 58-mm disk having a bead running across its diameter. A small-scale test with an 8-mm disk having a thickness of 200μ enabled the metal structure at various points to be studied. These tests were used to study electron-beam welding of 18/10 stainless steel and U-1.5 Mo and U-0.2 V alloys. (FR)

20378 THERMAL, ELECTRICAL, AND EMISSIVE PROPERTIES OF HAFNIUM IN THE HIGH-TEMPERATURE REGION. Arutyunov, A. V.; Banchila, S. N.; Filippov, L. P. (Moscow State Univ.). High Temp. (USSR) (Engl. Transl.); 10: No. 2, 375-377 (1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 2, 425-428 (1972).

Variable induction heating was used in the experiments. Use of this method made direct measurements of thermal diffusivity, specific heat, thermal conductivity, electric conductivity, and emissivity possible. Data on the properties are presented in tables and graphs. (JRD)

20379 EFFECT OF INITIAL STRUCTURE ON THE HIGH-TEMPERATURE STRENGTH OF WELDED JOINTS. Vaclav, P. Zvaranie; 20: No. 9-11, 374-380(1971). (In Czech).

Cr-Mo-W-V and Cr-Mo-W-V-Zr alloys (the compositions are given) were welded for steam-turbine application, operating at 550°C. The composition and microstructure of the weld-metal, x-ray patterns, and mechanical properties were determined. (Metals Abstr.)

20380 CONCENTRATION DEPENDENCE OF RESISTIVITY OF HARD NONORDERED BINARY ALLOYS OF NONTRANSITION METALS. Zelyavskii, V. B.; Khar'kov, E. I. (Kiev State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 11, 1783-1877(Nov 1972). (In Russian).

Electrical resistivity and its concentration dependences are obtained for hard nonordered binary alloys of nontransition metals (Al-Zn, Pb-In, Pb-Sn) within a solubility range. The results obtained are discussed in terms of the metal-diffraction model. Comparison is made with the calculation results based on the earlier theory of Mott. (auth)

Radiation Effects

Refer also to abstracts 21506, 21516, and 21517.

20381 (CEA-CONF-2052) SWELLING OF NICKEL IRRADIATED BY MEDIUM-ENERGY HEAVY IONS. Le Naour, L.; Azam, N. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 15 May 1972. 19p. (In French). (CONF-720570-2). Dep. NTIS (U. S. Sales Only).

From Conference of the French Society of Electron Microscopy; Nantes, France (29 May 1972).

High-purity Ni was irradiated with 500-keV Ni^+ ions and the effect of temperature on the swelling was studied. The swelling peak as a function of temperature was between 600 and 650°C. There does not seem to be any important difference between the effects of irradiation by ions and by neutrons. The form, distribution, evolution of the defects produced have a great similarity. The only notable peculiarity is the displacement toward the higher temperature of the swelling peak. (JSR)

20382 (CONF-721111-20) COMPARATIVE STUDY OF BLISTERING IN Nb, V, and V-20% Ti. Das, S. K.; Kaminsky, M. (Argonne National Lab., Ill.). 1972. 23p. Dep. NTIS.

From International Meeting on the Technology of Controlled Thermonuclear Fusion Experiments and the Engineering Aspects of Fusion Reactors; Austin, Texas, United States of America (USA) (20 Nov 1972).

A comparative study of the radiation blistering of the surfaces of polycrystalline niobium, vanadium, and vanadium-20 wt%

titanium alloy was made for different doses of helium ions implanted at 0.5 MeV for target temperatures ranging from room temperature to 900°C. The degree of blistering appears to decrease with increasing irradiation temperature for all three materials studied. Both at room temperature and at 900°C, the degree of blistering appears to decrease slightly in the order Nb, V, and V–20% Ti alloy. Estimates of the surface erosion of annealed polycrystalline Nb and V implanted at room temperature with 0.5-MeV helium ions indicate that the erosion by this blistering process is approximately two orders of magnitude faster than the erosion by physical sputtering under the same conditions. The results suggest that, in most of the structural materials considered for fusion reactors, helium blistering will be an important erosion process. (auth)

20383 (HEDL-SA-407) EFFECT OF PRIOR MICROSTRUCTURE ON NEUTRON DAMAGE IN STAINLESS STEEL. Laidler, J. J.; Mastel, B. (Hanford Engineering Development Lab., Richland, WA). Apr 1972. Contract AT(45-1)-2170. 3p. (CONF-720842-1). Dep. NTIS.

From 30th Annual Meeting and 1st Pacific Regional Conference on the Electron Microscopy Society of America; Los Angeles, California, United States of America (USA) (14 Aug 1972).

Results of irradiation experiments using ^{316}stainless steel foils are presented. It was found that the radiation damage structure follows a trend which is closely associated with the dislocation substructure prior to irradiation. Details concerning distribution of dislocation loops, defects, and voids are included along with figures used to illustrate microstructure. (JRD)

20384 (HEDL-SA-469) FAST REACTOR INDUCED CREEP IN 20 PERCENT COLD-WORKED TYPE 316 STAINLESS STEEL. Gilbert, E. R.; Kaulitz, D. C.; Holmes, J. J.; Claudson, T. T. (Hanford Engineering Development Lab., Richland, WA). 1972. Contract AT(45-1)-2170. 20p. (CONF-721115-4). Dep. NTIS.

A fully instrumented creep test was conducted in EBR-II. Strain in a uniaxial specimen of 20% cold-worked 316 stainless steel stressed at 138 MN/m^2 was measured during irradiation, whereas the diametral strains on four individually pressurized segments of 20% cold-worked 316 stainless steel cladding were determined by post-test measurements. The specimens showed significant flux-induced creep. Both transient and steady-state creep were observed in uniaxial test. The average strain rates in the pressurized tubes indicated linear stress dependence; however, the biaxial transient strains were less on a strain-per-unit stress basis than in the biaxial specimen. The creep rate during steady reactor operation was higher than that averaged over several reactor cycles suggesting that strain recovery occurred during reactor outages, even though stress was maintained throughout the outages. The creep rate in 20% cold-worked Type 316 stainless steel was less than that published for solution-treated M316 stainless steel springs in DFR and less than that published for mill annealed Type 304L stainless steel in EBR-II when normalized for the specific test conditions. (auth)

20385 INVESTIGATION OF MOLYBDENUM IRRADIATED WITH SINGLY CHARGED HELIUM IONS. Bykov, V. N.; Zdorovtseva, G. G.; Troyan, V. A.; Khaimovich, V. S.; Bevz, V. A. (Moscow Engineering-Physics Inst.). Fiz. Metal. Metalloved.; 34: No. 3, 666-668(Sep 1972). (In Russian).

The radiation-induced distortion in layers of Mo was studied through observing changes in the x-ray diffraction pattern after exposing Mo samples to 55-keV He^+ ions. The ratio of the tetragonal axes c/a and the electrical resistance in irradiated samples were studied as functions of the depth of the outer layers of Mo to about 6 μ. The greatest amount of distortion was found at a depth of 1.5 to 2 μ from the surface of the samples, and distortion was altogether absent at 3 to 4 μ. (KSW)

20386 INFLUENCE OF GAMMA RADIATION ON CARBON REDISTRIBUTION IN A MARTENSITE LATTICE. Kritskaya, V. K.; Krulikovskaya, M. P.; V'yunnik, L. M.; Narkhov, A. V. (Inst. of Metal Science and Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 34: No. 3, 502-507(Sep 1972). (In Russian).

The crystal structure of martensite in carbon steel which had been irradiated by hard gamma quanta (^{60}Co) was investigated by x-ray methods. Anomalous changes in the tetragonality of the lattice in the irradiated martensite were detected and attributed to redistribution processes of C in Fe_α–C solid solution. New states formed in the martensite lattice were due to changes in the degree of ordering in the arrangement of C atoms. An excess of point defects, introduced into the lattice by the gamma irradiation, was essential for these unusual processes. (tr-auth)

20387 IRRADIATION-INDUCED EMBRITTLEMENT OF MAGNOX CANS. Gibbs, G. B.; Harris, J. E. (Central Electricity Generating Board, Berkeley, Eng.). Radiat. Eff.; 16: No. 3-4, 267-270(Oct 1972).

The creep ductility of Magnox AL80 (Mg–0.8 wt % Al–0.005 wt % Be) fuel element cans is known to decrease with increasing irradiation. A possible cause of this embrittlement is void nucleation at inert gas bubbles formed on grain boundaries. The necessary size and spacing of these bubbles are calculated together with the total number of gas atoms which they must contain. The numbers of inert gas atoms arising from the following processes are also calculated: (a) the lithium (n,α) reaction, (b) the injection of fission fragments into the can, (c) fission of plutonium which has diffused into the can. Each mechanism can produce more than the theoretical minimum quantity of gas to account for the observed embrittlement. However, the appropriate grain boundary distribution of gas is unlikely to arise from (b) and (c) and the quantity from from (a) exceeds the minimum only slightly, even if all the gas is in bubble nuclei. The need for continued control over the lithium content of the canning stock material is emphasized. It is demonstrated that greater plutonium penetration could cause extensive embrittlement of a Magnox ZR55 (Mg-0.55 wt % Zr) alloy can. (auth)

20388 SEM HOT-STAGE INVESTIGATION OF SURFACE BUBBLE FORMATION AND RUPTURE IN HELIUM-IMPLANTED RARE EARTH FILMS. Blewer, R. S.; Maurin, J. K.; (Sandia Labs., Albuquerque, NM). pp 444-445 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

20389 EFFECT OF PRIOR MICROSTRUCTURE ON NEUTRON DAMAGE IN STAINLESS STEEL. Laidler, J. J.; Mastel, B. (Westinghouse Hanford Co., Richland, WA). pp 674-675 of Proceedings of the Thirtieth Annual Meeting on the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

20390 EFFECTS OF IMPURITIES ON VOID FORMATION IN α-IRON. Sprague, J. A. (Naval Research Lab., Washington, DC). pp 676-677 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

20391 RADIATION-DAMAGE STUDY OF TYPE 304 AUSTENITIC STAINLESS STEEL BY HIGH-VOLTAGE ELECTRON MICROSCOPY. Das, G.; Mitchell, T. E. (Case Western Reserve Univ., Cleveland). pp 678-679 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

20392 RADIATION DAMAGE STUDIES WITH THE HVEM. Laidler, J. J.; Mastel, B. (Westinghouse Hanford Co., Richland, WA). pp 680-681 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

Other Materials

Refer also to abstracts 19781, 20212, and 20314.

20393 (BNWL-SA-4400) RADIATION EFFECTS IN GRAPHITE IN RELATION TO ITS ROLE IN FUSION REACTORS. Gray, W. J.; Morgan, W. C. (Battelle Pacific Northwest Labs., Richland,

Wash.). 1972. Contract AT(45-1)-1830. 20p. (CONF-721111-24). Dep. NTIS.

From International Meeting on the Technology of Controlled Thermonuclear Fusion Experiments and the Engineering Aspects of Fusion Reactors; Austin, Texas, United States of America (USA) (20 Nov 1972).

Graphite has several properties which make it a potential material for some CTR components. The response of graphite under irradiation must also be considered in the engineering design stage. The authors review radiation-effects data that have been compiled in support of fission-reactor designs and briefly discuss the application of this data to CTR designs. (auth)

20394 TESTING OF GRAPHITE COMPOSITES IN AIR AT HIGH TEMPERATURES. Bortz, S. A. (Illinois Inst. of Tech., Chicago). pp 49-56 of Ceramics in Severe Environments. Kriegel, W. W. (ed.). New York; Plenum Publishing Corp. (1971).

From Conference on Ceramics in Severe Environments; Raleigh, North Carolina, United States of America (USA) (7 Dec 1970). See CONF-701206-.

Extreme environments associated with atmospheric re-entry require materials capable of withstanding severe thermal and mechanical conditions. Generally, data available from tests made under ambient conditions of previously oxidized material, or from tests of materials made at elevated temperatures in an inert atmosphere, do not relate well to properties of materials in the actual re-entry environment. Procedures were developed for high-temperature testing in air. The loss of material with time was measured and correlated with observed strength data. Shapes of temperature-strength curves for oxidized JTA graphite were similar to those obtained under inert conditions. As anticipated, strengths after oxidation were lower, depending on the length of exposure. (auth)

20395 EXPERIMENTAL POST-IRRADIATION RESULTS ON SPECIAL GAMMA AND NEUTRON–GAMMA SHIELDING CONCRETES. Balanescu, M. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 24: No. 9, 1079o-1097(1972). (In Rumanian).

Tests were performed on barite serpentine concrete samples irradiated in the Melusine pool-type reactor at CEN-Grenoble. Measurements were made on the irradiated samples in a leak-proof hot cell. The following parameters were measured: mass and length variations, elasticity modulus, and compression modulus. Results for these irradiated samples, compared with similar results obtained in other countries, support the conclusion that neutron irradiation always induces dimensional as well as strength variations in the materials tested. (auth)

20396 SOLID LUBRICANTS AND SELF-LUBRICATING SOLIDS. Clauss, F. J. New York; Academic Press, Inc. (1972). 269p. $17.00.

After an introductory chapter on friction and lubrication, inorganic lubricants and organic self-lubricating solids are discussed. The remaining ten chapters cover respectively: low-friction inorganic solids, graphite, MoS_2, miscellaneous inorganic compounds (dichalcogenides, lead compounds, fluorides, BN), soft metals, plastics (general), nylon, fluorocarbons, miscellaneous thermoplastics, and phenolics. (DLC)

20397 THERMAL CONDUCTIVITY OF CARBON MATERIALS AT HIGH TEMPERATURES BY A MODULATED ELECTRON BEAM TECHNIQUE. Tanaka, T.; Suzuki, H. (Tokyo Inst. of Tech.). Heat Transfer–Jap. Res.; 1: No. 4, 31-35(1972).

The thermal diffusivities of carbon materials were determined over the temperature range from 1300 to 1900°C, by using the modulated-electron-beam technique. The thermal conductivities were calculated from the diffusivity values obtained by this method and the values of heat capacity available in published literature. The resulting data was found to exhibit anisotropic properties, which were attributable to the method of preparation of the materials. The largest anisotropy was observed in pyrolytic graphite, whose ratio of anisotropy was about 100 in this temperature range. The anisotropy ratio of mold-pressed natural graphite was about 3, which was larger than that of artificial graphite. The thermal conductivities of glassy carbon appeared to be independent of temperature, and were 2.7×10^{-2}, 2.4×10^{-2}, and 2.2×10^{-2} cal/sec cm °C for the qualities called GC-30S, GC-30 and GC-20, respectively. (auth)

20398 EFFECT OF OXIDATION ON THE PRESSING BEHAVIOR OF FINE GRAPHITE POWDERS. Toporov, G. N.; Fialkov, A. S.; Semenov, M. V. Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 8, 669-672(Aug 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 8, 85-88(Aug 1972).

Fine comminution causes graphite to lose its compactibility. The original compactibility may be restored by subjecting such powders to oxidation, in air at 400°C or in a mixture of nitric and sulfuric acids (1:4) at 150°C. Sintering approximately doubles the strength of compacts pressed from powders oxidized in air. With increase in the specific surface of air-oxidized graphite powders, the strength of compacts from such powders in both the unsintered and sintered conditions steadily rises. Fine oxidized graphite powders can be employed in various fields of industry for the manufacture of pure graphite parts, containing no binder additions, and as constituents of a variety of composite materials. (auth)

20399 EXPLOSIVELY ACTUATED REACTION VESSEL FOR GAS INJECTION AND HIGH VACUUM APPLICATIONS IN PULSED ENERGY EXPERIMENTS. Lynch, A. W.; Meyer, R. T.; Freese, J. M. (Scandia Labs., Albuquerque, NM). Nucl. Instrum. Methods; 106: No. 3, 605-607(1973).

A reaction vessel for studies of the interaction of high-energy radiations and particles with materials is described for use in the environment of underground nuclear tests. (auth)

20400 PROCESS PARAMETERS AFFECTING THE VISCOSITY OF A THERMOPLASTIC SLURRY AND THE PROPERTIES OF NIOBIUM-CARBIDE-BASE SLURRY CASTINGS. Avgustinik, A. I.; Ordan'yan, S. S.; Kudryasheva, L. V.; Vigdergauz, V. Sh. (Leningrad Inst. of Tech.). Sov. Powder Met. Metal Ceram. (Engl. Transl.); 11: No. 8, 615-618(Aug 1972).

Translated from Porosh. Met., Akad. Nauk Ukr. SSR; 11: No. 8, 16-20(Aug 1972).

A study was made of the viscosity of casting systems based on niobium carbide powders of various degrees of dispersion and containing various amounts of binder (paraffin) and of the effect of temperature on this property. The principal density, porosity, and shrinkage characteristics of these parts, determined after heat treatment in a vacuum furnace at 2100°C, are listed. It is noted that the final properties of such parts after calcining (particularly their density and porosity) are governed by the amount of binder introduced into the casting system and the degree of dispersion of the niobium carbide powder employed. (auth)

20401 METHOD FOR THE PREPARATION OF ARTIFICIAL GRAPHITES AND MATERIALS SIMILAR TO GRAPHITE. Luhleich, H.; Nickel, H.; Pflaum, P. (to Kernforschungsanlage Juelich GmbH). German Patent 2,040,252. 17 Feb 1972. 8p. (In German).

The patent claims relate to the production of artificial graphites or graphite-like material (fine-grained graphites), with the binding agent being partly or completely dissolved in a liquid in which the filler has been well distributed beforehand. This solution then becomes a liquid that mixes with the solvent but does not dissolve the binding agent so as to form an emulsion. Thus the grains or particles of the filler are covered with a thin layer of the binding agent and sink down to the bottom where they form a slimy layer which is retained in the usual way by decantation of the supernatant and subsequently dried. According to the procedure, the slime layer is rewashed prior to drying with the liquid used for the formation of the emulsion, with the dried material being ground to a given grain size. (GF)

20402 RADIATION EFFECTS ON FLUOROPLASTIC COATINGS. Shigorina, I. I.; Egorov, B. N. Lakokrasoch. Mater. Ikh Primen.; No. 1, 37-40(1972). (In Russian).

The following materials were tested in the form of free film and as coatings on carbon steel: lacquer SP-FP-1 (a solution of the copolymer 32P in an acetone–butyl acetate mixture) and lacquer SP-FP-5 (a solution of the copolymer 42P in a mixture of amyl acetate, methylethylketone, cyclohexane, and toluene). The film thickness was about 200 μ. The coatings were subjected to gamma irradiation from a ^{60}Co source with an intensity of 350 rad/sec in varying doses from 1 to 1,000 MR in air at 40°C. The adhesion, strength, relative elongation during stretching, hardness, elasticity, and impact resistance of the irradiated samples were studied. Gas evolution during irradiation and the solubility were measured in the case of the irradiated free films. The physicochemical changes of the irradiated coatings were tabulated and indicate that SP-FP-1 may be used in gamma fields of 10 to 100 MR, and SP-FP-5 in gamma fields of 100 to 500 MR. (tr-INIS)

20403 EFFECTS OF γ-RADIATION ON THE EPOXY–COAL TAR COMPOSITION. Shigorin, V. G.; Egorov, B. N.; Lapushkina, T. G. Lakokrasoch. Mater. Ikh Primen.; No. 2, 45-49(1972). (In Russian).

The chemical reaction of epoxide resin ED-6 with coal tar which resulted from the influence of γ radiation was studied by ir spec-

troscopy and the solubility of the products in toluene. The stability toward radiation of the epoxy–coal composition was interpreted, in part, in the light of a radiation-induced mechanism. The composition is recommended as a protective coating under conditions of γ irradiation and aqueous media. (tr-auth) (INIS)

20404 EVALUATION OF A BORON–EPOXY REINFORCED TITANIUM TRUSS. Corvelli, Nicholas; Carri, R. L. (Grumman Aerospace Corp., Bethpage, NY). J. Spacecraft Rockets; 9: No. 12, 851-2(Dec 1972).

Results of tests on boron/epoxy composite cylindrical buckling specimens, composite-to-metal bonded step joint specimens, and a boron/epoxy reinforced titanium truss are presented. Evaluation of these results shows a potential weight saving in space shuttle boosters by the use of boron/epoxy reinforced titanium tubular trusses over boosters using all-titanium structures. (JRD)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstract 19810.

20405 (ARH-SA-152) NUCLEAR MATERIALS MEASUREMENT UNCERTAINTY CALCULATIONS. Doerr, R. W.; Jordan, J. W. (Atlantic Richfield Hanford Co., Richland, Wash.). 5 Jan 1973. Contract AT(45-1)-2130. 19p. (CONF-730109-1). Dep. NTIS.

From AEC source and special nuclear materials meeting; Germantown, Maryland, USA (16 Jan 1973).

An overall measurements reliability system using the systematic and random errors associated with each element of measurement is functioning on a continued basis. Combined material balance uncertainties are developed by propagating errors developed from the individual element reliabilities. Assessment of the material-unaccounted-for developed by routine material balance accounting is made by comparison with these system uncertainties. (auth)

20406 (JAERI-M-4751) GLOSSARY FOR NUCLEAR MATERIALS MANAGEMENT AND SAFEGUARDS. Kuriyama, M.; Ishihara, T. (Japan Atomic Energy Research Inst., Tokyo). Mar 1972. 82p. (In Japanese). NTIS (U. S. Sales Only).

The glossary (English-Japanese) has been prepared for nuclear materials management and safeguards, including the definition of about 400 terms which are based on "Safeguards Dictionary," WASH-1173, 1971. (auth)

20407 (KFK-1700) R&D WORK ON SAFEGUARDING THE INPUT TO A FUEL REPROCESSING PLANT (ACCOUNTABILITY TANK). Nentwich, D.; Gupta, D.; Otto, H. E.; Scheuerpflug, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Systemtechnik und Reaktorphysik). Nov 1972. 117p. Dep. NTIS (U.S. Sales Only).

Special problems relevant to safeguards were investigated on an inactive 1:1 scale mockup of the input accountability tank of the reprocessing plant at Karlsruhe (WAK). In order to monitor uncontrolled movement of input solutions an ultrasonic measuring device was developed which gives evidence of the liquid present in the intact tank tubing. Different parameters influencing its performance were studied, like temperature, density, inhomogeneity, etc., of the liquid to be monitored. Furthermore, first steps were undertaken to develop an input accountability system with the help of tracers. Zinc and rhenium were used as tracers. In connection with the tracer studies a series of related problems was investigated, e.g., inhomogeneity distribution of the tracer in the solution, effectivity of the air-sparger, and possibilities of introducing the tracer into the tank. For comparison, careful tank calibrations were performed. Conclusions are drawn and recommendations for further work are given. (auth)

20408 (REG/G-5.2(12-72)) CLASSIFICATION OF UNIRRADIATED PLUTONIUM AND URANIUM SCRAP. (Directorate of Regulatory Standards (AEC), Washington, D. C.). Dec 1972. 1p. Dep. NTIS. DRS Washington, D. C.

Disposal and Storage

Refer also to abstract 19851.

20409 NUCLEAR CHIMNEY RADIOACTIVE WASTE DISPOSAL. Cohen, J. J.; Lewis, A. E. (to United States Atomic Energy Commission). U. S. Patent 3,706,630. 19 Dec 1972. Filed date 12 May 1971. 16p.

Aqueous fluidic forms of radioactive wastes are introduced into lower portions of a nuclear chimney wherein water is vaporized therefrom by radioactive decay heat and concentrated wastes are accumulated therein. High-level wastes, low-level wastes including particulates filtered from the steam and portions of the condensed steam serving as a coolant are introduced over an extended period of time in amounts proportioned to maintain chimney contents at a low temperature level. When sufficient wastes have accumulated input of coolant and radioactive waste is terminated and the cavity may be sealed after vapor output terminates. Radioactive heat output then is employed to melt the chimney contents and rock adjacent to the chimney portions so as to incorporate the radioactive materials into the molten rock. After radioactive heat output diminishes to a level insufficient to offset heat diffusion into the formation the molten mass solidifies permanently, trapping the residual radioactivity in an insoluble matrix. (Official Gazette)

Handling Equipment and Procedures

20410 (REG/G-3.1(1-73)) USE OF BOROSILICATE-GLASS RASCHIG RINGS AS A NEUTRON ABSORBER IN SOLUTIONS OF FISSILE MATERIAL. (Directorate of Regulatory Standards (AEC), Washington, D.C.). 8 Jan 1973. 1p. DRS, Washington, DC Free.

20411 (REG/G-3.4(1-73)) NUCLEAR CRITICALITY SAFETY IN OPERATIONS WITH FISSIONABLE MATERIALS OUTSIDE REACTORS. (Directorate of Regulatory Standards (AEC), Washington, D.C.). 8 Jan 1973. 1p. DRS, Washington, DC Free.

20412 RECOVERY AND RECONCENTRATION OF RADIOACTIVE GASES FROM THE CRYOGENIC TRAP. Corrigan, K. E.; Corrigan, H. H.; Mantel, J. (Wayne State Univ., Detroit). Radiology; 106: No. 3, 615-616(Mar 1973).

Procedures and equipment are presented for concentrating radioactive noble gases, collected in the cryogenic trap for storage or reuse. Two simple and straightforward procedures which have worked well are described, and some of the difficulties to be avoided are discussed. (auth)

20413 LARGE SCALE AEROSOL RELEASE FACILITY, 242-B BUILDING (9 NOV 1971) (ENGINEERING MATERIALS). (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). (CAPE-2317).

20414 CRITICALITY OF PLUTONIUM NITRATE SOLUTIONS CONTAINING BORATED RASCHIG RINGS. Lloyd, R. C.; Bierman, S. R.; Clayton, E. D. (Pacific Northwest Lab., Richland, WA). Nucl. Sci. Eng.; 50: No. 2, 127-134(Feb 1973).

Experimental criticality data on borated raschig rings in plutonium nitrate solutions are presented for use in establishing criticality safety limits and in verifying calculational methods for these type systems. The data cover the concentration range between 63- and 412-g Pu/liter for borosilicate-glass raschig rings containing 0.5 and 4.0 wt % boron, and stainless-steel raschig rings containing 1 wt % boron. Criticality was possible in all three experimental vessels used (12-, 18-, and 24-in.-diam cylinders, 42-in. high) with no raschig rings. With rings randomly loaded in the vessels only the 24-in. cylinder could be made critical and then only when loaded with the 0.5 wt % borated rings. The minimum critical volume for this system, poisoned with 19.27 vol % borosilicate-glass rings containing 0.5 wt % boron, was determined to occur at about 300 g Pu/liter as compared to 175- to 200-g Pu/liter without the rings. The minimum critical mass occurred at ~110-g Pu/liter with the system poisoned, as compared with 30-g Pu/liter if the system had not been poisoned. Exponential measurements on the subcritical assemblies, loaded with 4 wt % borated rings displacing 18.78 vol % solution, indicated that negative bucklings existed for all plutonium nitrate solutions having concentrations below 391-g Pu/liter. Similar measurements on the subcritical assemblies, loaded with 1 wt % borated stainless-steel rings displacing 27 vol % solution, indicated that negative bucklings existed for all concentrations below 412-g Pu/liter. Comparisons between the experimental data and the results of several calculational methods indicate that the validity of a particular calculational technique may be limited to a small concentration region. By treating the raschig rings as vertical parallel tubes displacing an equal volume of solution and using the Monte Carlo code KENO with GAMTEC-II cross sections averaged over the energy spectrum of the plutonium solution, k_{eff} values were calculated to within 2% of unity for the experimental critical assemblies presented in this paper. Other calculational methods and cross-section sets used resulted in values of k_{eff} departing from unity by as much as 12% low to 6% high, depending on the plutonium concentration. The various methods used are discussed. (auth)

20415 CRITICAL EXPERIMENTS WITH HOMOGENEOUS MIXTURES OF PLUTONIUM AND URANIUM OXIDES CONTAINING 8, 15, AND 30 WT. PERCENT PLUTONIUM. Bierman, S. R.; Clayton, E. D.; Hansen, L. E. (Pacific Northwest Lab., Richland, WA). Nucl. Sci. Eng.; 50: No. 2, 115-126(Feb 1973).

Data are presented from critical experiments with mixed PuO_2–UO_2 fuels containing 30.0, 14.62, and 7.89 wt % Pu and having H/X (H: Pu + U) atomic ratios of 47.4, 30.6, and 51.8, respectively. In addition to the experimental results, which can be used directly as integral benchmark checkpoints, derived critical sizes are presented for homogeneous mixtures, at theoretical density, of $^{239}PuO_2$–U (0.71)O_2–water in slab, spherical, and cylindrical geometries at the three experimental H/X atomic ratios. These

types of data provide the bases for establishing criticality safety control limits. Critical thicknesses of 10.80 ± 0.11, 11.56 ± 0.09, and 14.83 ± 0.60 cm were determined, respectively, for slabs of the 30.0, 14.62, and 7.89 wt % Pu-enriched fuels infinite in two dimensions and fully reflected with 15 cm of Plexiglas. Values of k_{eff} within 8 mk of unity were calculated for these three critical systems using either the diffusion theory code, HFN, or the transport theory code, DTF-IV, with the original GAMTEC-II cross-section data previously used at the Critical Mass Laboratory in correlating plutonium critical experiments with theory. Similar calculations with ENDF/B-II cross-section data yielded k_{eff} values within 12 mk of unity for these three one-dimensional slab assemblies. Except for the more highly moderated 8 wt % Pu-enriched fuel (H/Pu = 659), calculations with ENDF/B-II data resulted in higher k_{eff} values for the critical assemblies than did like calculations using the original GAMTEC-II cross-section library. In the case of the 8 wt % Pu enriched fuel, the computed values for k_{eff} were essentially the same for either of the cross-section sets used. (auth)

20416 UNIT FOR WASHING CLOSED RADIOACTIVE SOURCES. Sobchuk, V. M.; Bogoudinov, R. D.; Dmokhovskii, V. V.; Kareev, N. V.; Volkova, M. A.; Falileeva, E. P. (Moscow Scientific-Research Inst. of Roentgen-Radiology). Med. Radiol.; 18: No. 2, 45-49(Feb 1972). (In Russian).

A unit for washing closed radioactive sources is described. The method includes an intensive wash of the membrane surfaces with a detergent. The results of clinical tests showed that this unit is a step forward in the development of protection equipment, provides safeguarding of the work place and the medical personnel, and meets the demands made of equipment of a similar purpose. (auth)

Transportation

20417 (ORNL-TM-3844) PEACH BOTTOM SPENT FUEL ELEMENT SHIPPING CASK ACCIDENT, DECEMBER 8, 1971. Chandler, J. M. (Oak Ridge National Lab., Tenn.). Jul 1972. Contract W-7405-eng-26. 59p. Dep. NTIS.

The loaded Peach Bottom Single Element Shipping Cask DOT-SP-5938 was involved in a highway accident while en route to Oak Ridge National Laboratory from the Peach Bottom Reactor. The actions taken to report and investigate the accident and to prevent radiation damage to the environment are described. Pictured and discussed are the actions taken to safely retrieve the loaded cask from the ditch, complete its shipment to ORNL, perform detailed inspection of and correct minor damage to the cask support ring, and prepare the cask for prompt reuse. Procedures are recommended for instructing people involved in the shipment of highly radioactive materials. Preventive maintenance and periodic inspection plans for assuring shipping cask integrity are discussed. (auth)

20418 EFFECT OF THE 17TH OF DECEMBER 1971 BRUSSELS CONVENTION ON THE INSURANCE OF NUCLEAR OPERATORS CONCERNING DAMAGE TO CARGOS DURING CARRIAGE. Deprimoz, J. (Pool Francais d'Assurances des Risques Atomiques, Paris). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 95, 21-25(May 1972). (In French).

The measure that the Convention signed in Brussels on the 17th of December 1971 will change the conditions concerning the intervention of the civil liability insurors of the operator transporting nuclear substances by sea. Accidental damage caused to nonnuclear cargo transported on the same ship (neutral cargo) and accidental damage caused by the nuclear cargo of an operator to other nuclear substances transported by the same ship under the liability of different operators are considered. Studies are made of the nonaccidental radioactive contamination of the external surface of cargos and the hold of the ship during carriage. (FR)

20419 EFFECTS OF THE 17TH OF DECEMBER 1971 CONVENTION ON THE REGULATIONS CONCERNING THE LIABILITY APPLICABLE IN THE CASE OF NUCLEAR DAMAGE SUFFERED BY THE TRANSPORTING SHIP. Albano, R. (Ente Nazionale per l'Energia Elettrica, Latina, Italy). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 95, 38-41(May 1972). (In French).

The Brussels Convention concerning civil liability in the carriage of nuclear materials established the exoneration of the responsibility of any individual likely to be held responsible under international or national conventions in the field of maritime carriage, the exclusive responsibility being attributed to the operator of the nuclear installation. A particular disposition of this convention extends this exoneration to third party damage, damage caused to the nuclear installation, and damage caused to the means adopted to effect the carriage of the nuclear materials at the time of the accident. The effects of this new Brussels Convention on the rules determined on the basis of the Paris and Vienna Conventions are examined. (FR)

20420 DEVELOPMENT OF THE CIVIL NUCLEAR LIABILITY REGULATIONS ON THE MARITIME CARRIAGE OF NUCLEAR MATERIALS UP UNTIL THE 17TH OF DECEMBER 1971. Lagorce, M. (CEA, Paris). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 95, 15-20(May 1972). (In French).

The principal dates associated with the establishment of civil nuclear regulations and insurances are: 1958, date of the first project of the Convention on civil nuclear liabilities; 1968, date of the coming into force of the 29th of July 1960 Paris Convention and year of the Monaco Symposium; and 1971, date of the new Brussels Convention on the maritime carriage of nuclear materials. The priority of nuclear law over maritime law concerning the carriage of nuclear substances is discussed. (FR)

20421 INSURANCE OF THE NUCLEAR OPERATOR FOR NUCLEAR DAMAGE CAUSED TO THIRD PARTIES DURING TRANSPORT. Lacroix, F. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 95, 42(May 1972). (In French).

The effects of the Brussels Convention (17th of December 1971) on the insurance of the nuclear operator for damage caused to third parties during the maritime carriage of nuclear materials are studied. (FR)

20422 EFFECTS ON MARITIME LAW OF THE BRUSSELS CONVENTION OF THE 17TH OF DECEMBER 1971 CONCERNING CIVIL LIABILITY IN THE MARITIME CARRIAGE OF NUCLEAR MATERIALS. Du Pontavice, E. (Paris Univ., Orsay, France). Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 95, 26-37 (May 1972). (In French).

The chronology of the different international conventions is recalled. The effects of the Brussels International Convention (17th of December 1971) on maritime law are analyzed. The application of nuclear conventions to sea carriage are studied together with the persons concerned by the Brussels Convention (maritime carriage), the international conventions applicable in the field of maritime carriage (conventions whose applicability has been categorically reserved by the nuclear conventions and conventions likely to come into conflict with nuclear conventions), national laws applicable in the field of maritime carriage, exoneration of the responsibility of the maritime carrier, the origin of the responsibility of the nuclear installation operator, the responsibility of the operator of a nuclear ship, the inapplicability of the Convention to noncontracting states, and the states capable of participating in the Convention. (FR)

20423 SENDING OF RADIOACTIVE MATERIALS, EXEMPT FROM SPECIAL PRESCRIPTIONS, BY POST (DANGEROUS MATERIALS 1972 NO. 23). Rayonnements Ionis. Tech. Mes. Prot.; No. 4, 47-49(Oct 1972). (In French).

The text of the 15th of April 1945 regulation concerning the carriage of dangerous materials has been modified. A new article concerning the sending of radioactive materials by post (materials having radiotoxicities of I, II, III, and IV, ^{14}C, tritium, ^{233}U and ^{235}U) has been added. (FR)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstract 21089.

20424 (FEI-303) EG-1 TYPE 5-MeV ELECTROSTATIC ACCELERATOR FOR NEUTRON SPECTROMETRY BY THE TIME-OF-FLIGHT METHOD. Volodin, V. I.; Glotov, A. I.; Dudkin, N. I.; Kanaki, V. N.; Romanov, V. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1971. 9p. (In Russian). INIS.

The ion-optic train of the 5-MeV EG-1 electrostatic accelerator and its operation in a pulsed regime are described. The construction of a high-frequency ion source with an indium seal on the discharge chamber is outlined. The parameters of the accelerated ion beam were: amplitude of pulses of the proton beam, about 1 mA; pulse duration, 15 to 500 nsec; and sequence frequency, up to 700 kHz. The pulse duration of the proton beam was measured using time-of-flight techniques in connection with the peak width of the gamma rays from the reaction $^{7}Li(p,\gamma)Be$. (tr-auth)

20425 (IFVE-INZ-71-116) CALCULATION PARAMETERS OF THE INITIAL PART OF AN ACCELERATOR WITH RF QUADRUPOLE FOCUSING. Mal'tsev, A. P.; Stepanov, V. B.; Teplyakov, V. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 30p. (In Russian). INIS.

The parameters of the initial portion of an accelerator were calculated for operation in conjunction with the experimental section of a linear accelerator with radiofrequency quadrupole focusing. The acceleration system was based on a double H-resonator. Focusing was accomplished by electrons which represented a modulated, four-conductor line. The theory and method of calculation are explained, and the construction is described. (tr-auth)

20426 (JPRS-58160) POSSIBILITY OF BUILDING PULSED ELECTRON ACCELERATORS WITH ENERGIES OF 20 TO 50 MeV. Mkheidze, G. P.; Rayzer, M. D.; Rabinovich, M. S.; Rukhadze, A. A. Translated from Kratk. Soobshch. Fiz.; No. 3, 67-74(1972). 7p. NTIS.

The possibility of building high-current pulsed electron electrostatic accelerators with energies of 20 to 50 MeV is discussed. (JPRS)

20427 (LA-5115) PROCEEDINGS OF THE 1972 PROTON LINEAR ACCELERATOR CONFERENCE, OCTOBER 10-13, 1972. (Los Alamos Scientific Lab., N. Mex.). Nov 1972. Contract W-7405-eng-36. 441p. (CONF-721046-). Dep. NTIS.

A separate abstract was prepared for each of 47 of the 60 papers presented at the conference. The remaining 13 papers were previously abstracted in NSA. For abstracts of these see CONF-721046 in the Report Number Index. (WHK)

For abstracts of individual papers see: 20428-20448, 20457-20468, 20481-20485, 20490-20495, 20502, 20505, and 20506.

20428 (LA-5115, pp 4-11) STATUS AND PERFORMANCE OF LAMPF. Nagle, D. E. (Los Alamos Scientific Lab., NM). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10-13, 1972.

Topics discussed include injectors, the drift-tube linac, tube experience, beam loss, fast phase and amplitude control, central computer control, and the experimental program. (WHK)

20429 (LA-5115, pp 17-24) OPERATING EXPERIENCE WITH THE NAL 200-MeV LINAC. Curtis, C. D.; Gray, E. R.; Livdahl, P. V.; Owen, C. W.; Shea, M. F.; Young, D. E. (National Accelerator Lab., Batavia, IL). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10-13, 1972.

Reliability of the linac operation as an injector has been about 95%. Beam emittance and momentum spread are within the design range at currents below 30 to 40 mA but increase slowly with beam current to somewhat larger than design values at 80 mA at the present time. Emittance growth through the linac is typically a factor of two, occurring principally between 750 keV and 10 MeV for low currents, but with significant growth between 10 MeV and 200 MeV for high currents. The brightest beams are the high-current beams. Coupling between transverse planes is indicated. Further study of the high-current beams is needed. (auth)

20430 (LA-5115, pp 25-32) STATUS REPORT ON THE UNILAC PROJECT. Boehne, D. (Gesellschaft fuer Schwerionen forschung mbH, Darmstadt, Ger.). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10-13, 1972.

The beam parameters of the UNILAC are reviewed, and tentative figures are given for an early start-up phase at the end of 1974. Recently completed design work is reported and comments are given on the progress of component procurement and building construction. (auth)

20431 (LA-5115, pp 33-40) ACCELERATOR RESEARCH AND DEVELOPMENT WITH THE CERN 3-MeV LINAC. Warner, D. J. (CERN, Geneva). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10-13, 1972.

Topics discussed include parameters of the 3-MeV linac, some calibrations made at the assembly stage, initial operation with a 3-MeV beam, rf problems, measurements made during high-current operation, component and system tests, and comments on engineering. (WHK)

20432 (LA-5115, pp 82-89) CURRENT STATUS OF SUPERCONDUCTING ACCELERATOR TECHNOLOGY. Wilson, P. B. (Stanford Linear Accelerator Center, CA). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10-13, 1972.

A summary of the activities of various international laboratories involved in superconducting accelerator projects is given. Also, two specific limitations on superconducting cavities are considered: the effect of exposure to gases and limitations on peak rf fields. A statistical model for magnetic field breakdown is briefly discussed. (32 references.) (WHK)

20433 (LA-5115, pp 93-97) FIRST OPERATION OF A SUPERCONDUCTING PROTON ACCELERATOR. Brandelik, A. (Univ., Karlsruhe, Ger.); Citron, A.; Flecher, P.; (and others). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10-13, 1972.

The injection, helix structure, focusing, cryostat, chopper-buncher system, and rf controls are briefly described. Results of the first runs are outlined. (WHK)

20434 (LA-5115, pp 103-113) MECHANICAL DESIGN FEATURES OF THE UNILAC. Niewodniczanski, T.; Malwitz, E. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt, Ger.). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10-13, 1972.

The design of the mechanical components of the UNILAC are reviewed as well as some results of prototype tests and of different technological approaches. Preliminary results on copper plating of the test cavities with Q values higher than 95% of their theoretical value are discussed. Some data about the tank electroplating plant are given. The mechanical design of the Widerŏe and Alvarez structure and the single-gap cavities is given. Some details are given on the tank design as well as on the different versions of drift tubes. A general description of the cooling water system is included. (auth)

20435 (LA-5115, pp 114-118) STUDY OF HIGH-ENERGY PROTON LINAC STRUCTURES. Andreev, V. G.; Belugin, V. M.; Kulman, V. G.; Mirochnik, E. A.; Pirozhenko, B. M. (Radiotechnical Inst., Moscow). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10-13, 1972.

Two $\pi/2$-mode standing wave structures are described, one of which contains annular coupling cells and the other is loaded with disks interspersed with conducting washers. Both structures can be used in a proton linac with a higher than 100 MeV output energy. Calculated parameters of structures are presented together with results of experimental studies of models thereof. (auth)

20436 (LA-5115, pp 140-144) BEAM TESTS WITH S-BAND STANDING WAVE ACCELERATORS USING ON-AXIS COUPLERS. Schriber, S. O.; Heighway, E. A.; Funk, L. W. (Chalk River Nuclear Labs., Ont.). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

Two electron S-band standing wave accelerators employing on-axis coupling cells have been designed and tested in the $\pi/2$ mode: one with 6 accelerating cells and the other with 21 accelerating cells. The maximum average accelerating gradient achieved with the 6-cell structure was 18 MeV/m. Rf drives to the accelerators were from pulsed magnetrons operating at 3 GHz. Experimental measurements of the output beam characteristics including beam profile and energy measurements are presented as a function of electron gun injection energy, rf field levels and injection timing. (auth)

20437 (LA-5115, pp 151-155) MEASUREMENTS ON THE FIRST SECTION OF THE SUPERCONDUCTING PROTON LINAC AT KARLSRUHE. Fricke, J. L.; Piosczyk, B.; Vetter, J. E. (Univ., Karlsruhe, Ger.). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

The design of the first section of the proton linac at Karlsruhe, a resonator loaded with five electrically coupled helices, is described. Measurements of the first two test runs are presented. Results for quality factors and maximum obtained field strengths are given. Peak electric fields of 18 MV/m and corresponding peak magnetic fields of 530 Gauss were reached at $Q = 3.3 \times 10^7$. Field emission did not affect high field Q's significantly. This low β structure has accelerated protons with the design value of 1 MeV/m energy gain (particle phase = $-30°$) in CW operation. (auth)

20438 (LA-5115, pp 175-181) STANFORD RECIRCULATING LINEAR ACCELERATOR. Panofsky, W. K. H. (Stanford Linear Accelerator Center, CA). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

A brief outline of the historical motivation and the design of Stanford Recirculating Linear Accelerator (RLA) is presented. The installation should further greatly increase SLAC's power as a research tool in physics; RLA is expected to double the energy of SLAC and increase its duty cycle 100-fold at present energy. Since the projected cost is about 10% of the initial capital investment in SLAC, this improvement program appears to be of very great value in relation to its cost. (auth)

20439 (LA-5115, pp 191-196) LIMITATIONS OF ACCELERATION OF DEUTERONS IN ALVAREZ-TYPE PROTON LINACS. Ohnuma, S. (National Accelerator Lab., Batavia, IL); Sluyters, Th. Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

It is shown that there exists a precarious balance among rf fields, the injection energy, and the injection phase for the optimum deuteron acceleration in a proton linac. Also, a proper choice of the quadrupole strengths in the first tank is required to accommodate the wild phase oscillations. (WHK)

20440 (LA-5115, pp 197-204) MODERN ELECTRON LINACS AND NEW USER NEEDS. Leiss, J. E. (National Bureau of Standards, Washington, DC). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

The desires of electron linear accelerator users are examined and the status of linac technology discussed in an attempt to identify areas where substantial new electron linac developments are desired and possible. The two major areas of need and capability identified are those of high-duty cycle accelerators and those of high-pulse beam current accelerators. Examples of developments in each of these areas are presented which indicate that accelerators satisfying users' needs can be built. (auth)

20441 (LA-5115, pp 218-225) CHALK RIVER HIGH CURRENT TEST FACILITY. Chidley, B. G.; Hodge, S. B.; Brown, J. C.; Ormrod, J. H.; Ungrin, J. (Chalk River Nuclear Labs., Ont.). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

The development of a high-current 100% duty factor proton linac for possible use in electronuclear breeding of fissile materials is described. The injector, linac tank, and rf power system are described. The High Current Test Facility is scheduled for completion next year. (WHK)

20442 (LA-5115, pp 226-232) CHALK RIVER ELECTRON TEST ACCELERATOR. Fraser, J. S.; Kidner, S. H.; McKeown, J.; McMichael, G. E. (Chalk River Nuclear Labs., Ont.). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

A test accelerator which is being constructed for use with electrons ($\beta = 1$) to model the behavior of intermediate energy protons ($\beta = 0.2$ to 0.8) for the development of a 100% duty factor proton linac for possible electronuclear production of fissile materials is described. (WHK)

20443 (LA-5115, pp 265-274) RECENT WORK ON THE HELIX STRUCTURE AND PROPERTIES OF TANDEM HELIX COMBINATIONS FOR THE ACCELERATION OF HEAVY IONS. Klein, H. (Univ., Frankfurt am Main); Junior, P.; Schempp, A.; Finke, P.; Herminghaus, H.; Klabunde, J.; Lehr, L. Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

Field stabilization in helical resonators can be achieved by compensating the structure in a relative simple manner. The influence of termination effects on field distribution and resonant frequencies of $\lambda/2$-helices is investigated. A modified normal conducting Talix accelerator in pulsed operation is described. Some figures are given for the expected beam performance of postaccelerators with superconducting helices. (auth)

20444 (LA-5115, pp 275-278) EXPERIENCE OF BIG PULSED CURRENT ACCELERATION ON THE LINAC I-2. Kapchynskii, I. M.; Batalin, V. A.; Lasarev, V. I.; (and others) (Inst. of Theoretical and Experimental Physics, Moscow). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

Information is given about the operation of the linear accelerator I-2 injector of the ITEP proton synchrotron. The accelerated beam intensity is increased now up to 200 mA. Beam parameters, when big proton current is accelerated, are given; the operating conditions of the rf cavities are discussed under the acceleration of an intense beam. Some additional devices were put into operation. Among their number: preinjector modulator charging voltage stabilizer and apparatus for proton beam ejecting in the atmosphere during the pauses between main injection pulses in the synchrotron. (auth)

20445 (LA-5115, pp 310-313) MESON FACTORY INJECTOR COMPLEX. Avramenko, M. A.; Batskikh, G. I.; Golubev, V. P.; (and others) (Scientific Research Inst. of Electrophysical Apparatus, Leningrad). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

The high-current linac Meson Factory Injector complex at Leningrad is described. The beam parameters and a general layout of the complex are given. (WHK)

20446 (LA-5115, pp 326-329) DEUTERONS ACCELERATION WITH THE SATURNE LINAC. Chamouard, P. A.; Lefebvre, J. M.; Olivier, M.; Prome, M. (CEN, Saclay, France). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

The recent improvements on the linac deuteron beam allow the acceleration in the synchrotron of 9.10^{11} deuterons at 4 ms after rf capture and 8.10^{11} deuterons of maximum energy. Another conditioning should allow to tolerate a higher rf field, hence increasing the linac transmission. New optics well adapted to deuteron beams are under study for the preinjector and the transport system. They should also lead to an increase of the intensity at the entrance of the linac. Measurements made at Saturne injection show that the space charge limitation is not reached, therefore the number of accelerated particles will be directly proportional to the current delivered by the linac. (auth)

20447 (LA-5115, pp 330-337) SATURNE LINAC THREE YEARS OPERATION REPORT. Chamouard, P. A.; Olivier, M. (CEN, Saclay, France). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

Results of a statistical study of the operating time of the Saturne linac, considering maintenance, modification, and failure time, are given. (WHK)

20448 (LA-5115, pp 387-395) HIGH-CURRENT ION LINEAR ACCELERATOR FOR MEDIUM-ENERGY PHYSICS (MESON FACTORY). Murin, B. P.; Fedotov, A. P.; Kulman, V. G.; Batskikh, G. I.; Polyakov, B. I. (Radiotechnical Inst., Moscow). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

Main parameters and specific features of a 600-MeV linear accelerator, being designed to accelerate protons and negative hydrogen ions with an average current of 0.5 or 1 mA, are reviewed. (auth)

20449 (LA-5155) MEDIUM-ENERGY PHYSICS PROGRAM. Quarterly Report for the Period Ending October 31, 1972. Dunn, E. (Comp.). (Los Alamos Scientific Lab., N. Mex.). Jan 1973. Contract W-7405-eng-36. 48p. Dep. NTIS.

On September 29, 1972, LAMPF was officially dedicated and given the name the Clinton P. Anderson Meson Physics Facility. Development and research progress is reported including engineering support, accelerator systems development, electronic instrumentation and computer systems, accelerator operations, experimental area, research, and practical applications. Activities of the Program Advisory Committee and the LAMPF Users Group are outlined, and a list of accepted research proposals is given. (WHK)

20450 IMPROVEMENTS IN OR RELATING TO ELECTRIC HIGH VOLTAGE GENERATORS. Davies, A. (to United Kingdom Atomic Energy Authority). British Patent 1,297,786. 29 Nov 1972. Filed date 18 Jul 1969. 9p.

A high voltage generator of the Cockcroft–Walton type is described comprising a number of modular units each of which is made up of one or more Cockcroft–Walton stages mounted within an electrically conducting casing that forms an encompassing screen. The units have input and output terminals for demountable connection to each other, so that the voltage step-up of each unit is additive. The screen of at least one of the modular units is held at a potential midway between that of the input and output terminals of the modular unit. The generator may be used in combination with an inverter for supplying power to the modular units, the inverter comprising two thyristors having means for switching them on alternately, and connected for switching current from a source of direct current so as to provide an alternating current to an output load. A resonant circuit is connected to receive alternating current from the thyristors, arranged to resonate so that current reversal in the resonant circuit causes cut-off of that thyristor which is "on" before the other thyristor is triggered on. Two unidirectional overflow current paths connected across the thyristors bleed off reverse current from the resonant circuit after this has cut off the "on" thyristor; each unidirectional bleed current path includes an inductor, of the two paths share a common inductor. (UK)

20451 ACCELERATING TESTS ON THE FIRST SECTION OF THE KARLSRUHE SUPERCONDUCTING PROTON ACCELERATOR. Brandelik, A.; (Kernforschungszentrum, Karlsruhe, Ger.); Citron, A.; Flecher, P.; Fricke, J. L.; Hietschold, R.; Hochschild, G.; Hornung, G.; Klein, H.; Krafft, G.; Kuehn, W.; Kuntze, M.; Piosczyk, B.; Sauter, E.; Schempp, A.; Schulze, D.; Szecsi, L.; Vetter, J. E.; Zieher, K. W. Particle Accel.; 4: No. 2, 111-126 (Dec 1972).

A summary of recent tests made on the first section of the Karlsruhe superconducting linear accelerator is presented. The following elements were assembled: Cockcroft–Walton injector, chopper-buncher system, and first cryostat. The cryostat contained the first accelerating section and a superconducting quadrupole doublet while dummy sections were placed in the position of the second and third tanks and the second quadrupole doublet, allowing the beam to traverse the entire length of the cryostat. These tests were carried out in March and June 1972. The design field of $E_{axis}^{TW} = 1.155$ MV/m was obtained in stable operation. At an injection energy of 750 keV and the design field on the axis a maximum energy gain of 380 keV was measured with a continuous proton beam. (auth)

20452 THEORETICAL INTERPRETATION OF THE CHARACTERISTICS OF THE INTERDIGITAL STRUCTURE. Chabert A.; Voisin, G. (Univ. Claude Bernard, Lyon). Nucl. Instrum. Methods; 107: No. 1, 173-185(15 Feb 1973). (In French).

An attempt at the theoretical explanation of the characteristics of the interdigital linac structure is presented. The purpose is not to recall the properties of this structure, which have already been described as a result of experimental studies. Only a brief description of the theoretical method, which has been reported elsewhere, is given. The theoretical analysis of the dispersive properties, fields and related characteristics of the structure, as compared to the results of previous experiments, is discussed. This comparison allows the checking of both the validity of the theoretical model of the structure and the convergence of the computations. A good agreement appears between theoretical and experimental dispersion curves, but the theoretical description of the fields and electric properties (shunt-impedance, quality factor, distribution of currents and power losses in the walls) is less accurate, although still significant of their order of magnitude. In conclusion, since the main characteristics of the interdigital structure were already studied experimentally before the theoretical explanation, the contribution of their results to the design of accelerating interdigital cavities is moderate. However, the theoretical method, which is not limited to the interdigital case, could facilitate significantly the approach of other kinds of structures. (auth)

20453 PERFORMANCE CHARACTERISTICS OF ELECTRON RING ACCELERATORS. Moehl, D.; Laslett, L. J.; Sessler, A. M. (Univ. of California, Berkeley). Particle Accel.; 4: No. 3, 159-167(Feb 1973).

On the basis of our present understanding of the physical phenomena involved in an electron ring accelerator (ERA), a theoretical study is made of the performance which might be expected for an ERA. Rigorous upper bounds are obtained on the rate of energy gain, from which it is shown that, in order to prevent azimuthal instability, parameters must be selected such that (for reasonable fields, injector properties, etc., but with no safety factors) the proton energy gain is less than 80 MeV/m. Numerical examples and approximate formulas are given for the properties of rings satisfying the stability conditions for both azimuthal oscillations and ion–electron oscillations. It is found that for reasonable fields and injector properties, but without safety factors, the usable proton energy gain is less than 45 MeV/m. (auth)

Auxiliaries and Components

Refer also to abstracts 20906 and 21001.

20454 (AERE-M-2372) SIMPLE BEAM POSITION MONITOR USING Y.S.I. PRECISION THERMISTORS. Clear, B. P. (Atomic Energy Research Establishment, Harwell (England)). Dec 1972. 12p. Dep. NTIS (U. S. Sales Only). UK 50 pence.

A beam position monitor is described which operates by the detection of temperature differences between opposite ends of the horizontal and vertical diameters of the thin metal window through which the beam passes. Thermistors may be used for this purpose in a Wheatstone bridge network provided they remain accurately matched over the required temperature range. It was found that thermistors manufactured by the Y.S.I. Company (U.S.A.) were satisfactory for this purpose, and enabled a simple monitor to be constructed with a high position sensitivity, eliminating the need for preamplifiers. (auth)

20455 (BNL-17609) CALCULATED FREQUENCIES AND PEAK FIELDS OF TE_{01n} AND TE_{11n} MODES IN CYLINDRICAL CAVITIES. Bauer, W. (Brookhaven National Lab., Upton, N. Y.). 1 Feb 1973. 6p. Dep. NTIS.

Some formulas are collected which are often used in evaluating the rf properties of cylindrical cavities. In two tables the values of frequency, geometry factor, and peak field for TE_{01n} and TE_{11n} modes are given. (auth)

20456 (IFVE-SKU-71-73) DEVICE FOR BEAM MONITORING IN THE RING CHAMBER OF THE IHEP ACCELERATOR.

Gertsev, K. F.; Stolyarov, G. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 18p. (In Russian). INIS.

A device for converting analog signals of beams into numerical forms is described. The design and characteristics of the device and the individual junctions are given. The inaccuracy of the device during measurement of the deflected beam in the boundary of the halfwidth of the vacuum does not exceed ±3%, ±1 mm. An example of the use of the device for correction of the distortion of the magnetic field of the accelerator is given. (tr-auth)

20457 (LA-5115, pp 90-92) MAGNETIZATION CURVES OF SUPERCONDUCTORS: TYPE I, TYPE II, AND TYPE III. Matthias, B. T. (Univ. of California, La Jolla, San Diego). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

The Meissner effect in both ac and dc applications in Types I, II, and III superconductors is discussed. Magnetization curves are given. (WHK)

20458 (LA-5115, pp 98-102) RECENT MEASUREMENTS OF S-BAND AND L-BAND CAVITIES AT STANFORD. Lyneis, C.; McAshan, M.; Nguyen Tuong Viet (Stanford Univ., CA). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

Studies of S-band and L-band TM_{010} mode niobium superconducting cavities have been carried out to determine the mechanisms limiting microwave field levels in cavities and to test techniques for overcoming these limits. Electron loading is more prevalent in tests made at S-band and L-band than was found in earlier experiments at X-band. Peak surface electric fields as high as 35 MV/m in S-band niobium cavities and 22 MV/m in L-band niobium cavities have been achieved. Unloaded Q's greater than 10^{10} have been measured in both S-band and L-band cavities. In a 7-cell S-band structure, an effective accelerating voltage gradient of 6.5 MV/m and an unloaded Q of greater than 10^{10} were attained. (auth)

20459 (LA-5115, pp 145-150) SUMMARY OF MEASUREMENTS ON SUPERCONDUCTING HELICALLY LOADED RESONATORS. Vetter, J. E.; Piosczyk, B.; Fricke, J. L. (Kernforschungszentrum, Karlsruhe, Ger.). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

Two years of experiments with superconducting helically loaded resonators allow to give a survey on the specific properties of this type of resonator with respect to its use in a low β particle accelerator. The dominant effects are compiled and results important for accelerator applications are given. (auth)

20460 (LA-5115, pp 156-162) RF CONTROL OF SUPERCONDUCTING HELICALLY LOADED CAVITIES. Schulze, D.; Brandelik, A.; Hietschold, R.; Hochschild, G.; Hornung, A.; Spielboeck, F.; Szecsi, L. (Univ., Karlsruhe, Ger.). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

Test experiments to study rf problems in superconducting helically-loaded cavities are discussed. The rf problems are closely connected to the low mechanical rigidity of the structure: (1) The eigenfrequency excursion caused by external noise sources is much larger than the bandwidth; (2) radiation pressure induced strain results in eigenfrequency shifts up to 1% at the required field levels; and (3) at large field levels transfer of electrical into mechanical energy becomes significant, leading to self-excitation (ponderomotive instability). (WHK)

20461 (LA-5115, pp 163-167) SLOW TUNER FOR SUPERCONDUCTING HELICALLY LOADED RESONANT CAVITIES. Jones, C. M. (Oak Ridge National Lab., TN); Fricke, J. L.; Piosczyk, B.; Vetter, J. E. Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

A concept was developed for a device to control the static resonant frequency of superconducting helically-loaded cavities over a wide range and the concept was applied to the particular problem of the Karlsruhe proton accelerator. Basically, the device consisted of a Nb plunger attached to a dielectric cylinder which provides support and a path by which the plunger may be cooled with liquid helium. Model tests on the second Karlsruhe cavity showed that two such plungers can give a tuning range of 100 kHz at high field levels without significant surface field enhancement or disturbance of the flatness. Furthermore, with radiation pressure induced static frequency shifts up to 500 kHz, they permit constant frequency operation at arbitrary axial field levels without surface fields significantly in excess of those present at maximum axial field and without significant flatness disturbance. Related materials problems were studied and are discussed. (auth)

20462 (LA-5115, pp 168-174) PROGRESS IN THE DEVELOPMENT OF SUPERCONDUCTING RESONATORS FOR HEAVY ION ACCELERATION. Benaroya, R.; Jaffey, A. H.; Johnson, K.; (and others) (Argonne National Lab., IL). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

Topics discussed include stability and reproducibility, vibration studies, rf control, irradiation effects, and magnetic shielding and trapped flux. Plans for a helix accelerator prototype test and future plans are outlined. (WHK)

20463 (LA-5115, pp 205-208) PULSED DRIFT TUBE QUADRUPOLE MAGNETS WITH HIGH PRECISION. Tanaka, J.; Kobayashi, M.; Baba, H.; Inagaki, S.; Okumura, S. (National Lab. for High Energy Physics, Oho-machi, Japan). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

The drift tube quadrupole magnets for the KEK 20 MeV injector linac are described. New manufacturing processes of pulsed quadrupole magnets were developed to obtain such a high field gradient as 11 kG/cm, a high reliability and a high precision. The core of the magnet was divided into four quadrant cores. The core leaves are punched by a high precision die set, stacked on a jig and epoxidized to form a quadrant core block. The coils, instead of a wire-winding method, were made of copper blocks by machining. Four quadrant cores and a coil assembly were assembled on a jig. The deviations of the magnetic centers from the core center were within 0.02 mm for 90 magnets. (auth)

20464 (LA-5115, pp 233-241) HIGH POWER OPERATION OF TWO SIDE-COUPLED STANDING WAVE LINAC STRUCTURES. McKeown, J.; Schneider, H. R.; Schriber, S. O. (Chalk River Nuclear Labs., Ont.). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

The side coupled linear accelerator design developed at Los Alamos has been tested up to axial fields of 1.6 MV/m with 100% duty factor. The structures are stable at these power levels and have been used to accelerate a test electron beam to 1.34 MeV at average axial fields of 1.1 MV/m. Under these conditions the axial electric field tilts are less than 2.4% and the phase changes were found to differ by 1.3° from low power measurements. Milling the cooling channels into the segment structure reduces detuning at high power. Lack of water cooling in the side couplers is a weakness in the present designs and coupler cooling channels should be incorporated in future tanks to be used at high power. (auth)

20465 (LA-5115, pp 250-255) BRIDGE COUPLER DESIGN AND TUNING EXPERIENCE AT LOS ALAMOS. Potter, J. M.; Knapp, E. A. (Los Alamos Scientific Lab., NM). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

A bridge coupler is essentially a tuned rf power splitter which is an integral part of the accelerator structure, allowing an rf amplifier to drive more than one accelerator section while preserving the desirable properties of the $\pi/2$ mode for the combined structure. In its simplest form, a bridge coupler is an elongated accelerating cell of a biperiodic structure which is displaced off the beam axis to bridge over focusing magnets and beam diagnostic equipment. The design of bridge couplers for the linear accelerator at Los Alamos and the modifications of the basic design required to retain the stability and power-flow phase shift characteristics of the $\pi/2$ mode are described. These modifications involve the addition of a resonant post coupler (or couplers, depending on the bridge-coupler length) similar to those used to stabilize the Alvarez structure. An asymmetry in the post-coupler system al-

lows one to adjust the relative amplitudes of the fields in the coupled accelerating structures. (auth)

20466 (LA-5115, pp 349-355) REAL-TIME MEASUREMENTS OF PROTON BUNCH FORM. Evans, L. R.; Warner, D. J. (CERN, Geneva). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

The feasibility of real time proton bunch measurements at 500 keV has been demonstrated. There are some obvious areas where improvements could be made particularly in the bandwidth of the detection system and in suppression of arcing. In the secondary emission mode the coaxial probe gave encouraging results and showed that the reduction in bandwidth was acceptable. The coaxial probe technique has now been used successfully at 500 keV, 10 MeV, and 50 MeV but at the higher energies the bandwidth required was too high for phase spread measurements. However a possible region where lower bandwidth could be acceptable is after the debunching of a proton beam and before injection into a synchrotron. (auth)

20467 (LA-5115, pp 396-399) NEW BEAM-SPILL CONTROL SYSTEM FOR LAMPF. Parker, J. R.; Richardson, J. H.; Easley, J. D. (Los Alamos Scientific Lab., NM). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

The high-intensity beam of LAMPF requires careful control of beam loss to minimize activation of the beam channel. A beam-spill control system now in operation which limits the average beam loss to an amount allowed by activation criteria, without severely restricting accelerator tune-up and diagnostics work, is described. This average loss is maintained by downward modulation of the beam-pulse width and repetition rate until the loss-producing fault is corrected. Binary and analog signals describing the action are sent to the Central Control Computer where decisions regarding corrective measures can be made by either the operator or the computer. The computer can test all beam-spill monitors simultaneously while the machine is in operation. (auth)

20468 (LA-5115, pp 407-410) EXACT EQUILIBRIUM CURRENT SOLUTIONS FOR A SET OF LC COUPLED LOOP CIRCUITS WITH SECOND NEIGHBOUR COUPLING. Schriber, S. O. (Chalk River Nuclear Labs., Ont.). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

The treatment of second neighbor coupling in loop current solutions of the free oscillations of LC coupled loop circuits has usually been done using perturbation techniques. The exact equilibrium solutions for these currents are given: $i_n \propto \sin n\varphi + \alpha\cos n\varphi + \beta\sinh n\psi + \gamma\cosh n\psi$ where $\cosh\psi = -[\cos\varphi + (k_1/2k_2)]$ and k_1, k_2 are the first and second neighbor coupling constants and α, β, γ, and φ are functions related to the coupled resonant mode and the termination of the system. Relations for the $\pi/2$ mode with $k_2/k_1 \ll 1$ are given as well as the extrapolation of this method to many neighbor couplings. The solutions are useful for studying the effects of large second neighbor coupling and the effect second neighbor coupling has on the $\pi/2$ mode particularly the detuning required for the first and last cells. (auth)

20469 VERY HIGH FIELD SYNCHROTRON MAGNETS WITH IRON YOKES. Coupland, J. H.; Simkin, J.; Randle, T. C. (Rutherford High Energy Lab., Chilton, Eng.). Nucl. Instrum. Methods; 106: No. 3, 595-604(1973).

A variety of dipole and two quadrupole magnets have been studied using a computer. All the magnets have iron yokes in close association with the windings and conclusions are drawn about the error fields in the useful aperture arising from saturation in the yoke. Shaping the iron enables the saturation to be controlled, and magnets have been designed with errors small enough for use in proton synchrotrons with fields up to 6 T. (auth)

20470 RADIATION LEAKAGE THROUGH THIN CYCLOTRON SHIELD WALLS. Fulmer, C. B.; Butler, H. M.; Wallace, K. M. (Oak Ridge National Lab., TN). Particle Accel.; 4: No. 2, 63-68 (Dec 1972).

Thick targets of carbon, aluminum, copper, and tantalum were each bombarded with beams of protons, deuterons, α-particles, and carbon ions. The target station was 5.5 m from an 80 cm thick ordinary concrete shield wall. Measurements were made of radiation levels of fast neutrons, thermal neutrons, and γ-radiation on the shielded side of the wall for each target-beam combination. Total radiation levels due to leakage through the wall were thus determined as a function of beam intensity for targets of a wide range of atomic mass and for a variety of incident beam particles with energies in the range of 8 to 66 MeV/amu. Deuteron beams result in the highest radiation levels (for a given beam energy). Measurements on both sides of the wall indicate that neutrons are the principal radiation leakage through the wall. Neutron induced reactions in the wall, however, result in significant levels of γ-radiation on the shielded side of the wall which are ~50 percent of the total rem dose. (auth)

20471 HIGH GRADIENT PRECISION QUADRUPOLE MAGNETS FOR KEK LINEAR ACCELERATOR. Kobayashi, M. (National Lab. for High Energy Physics, Ibaraki, Japan); Tanaka, J.; Baba, H.; Inagaki, S.; Okumura, S.; Yamashita, S. Particle Accel.; 4: No. 2, 87-99(Dec 1972).

New manufacturing processes of drift tube quadrupole magnets were developed to obtain a high field gradient of 11 kG/cm and a high mechanical precision. A total of 90 magnets for the KEK linac were constructed with a tolerance of 20 μm for the difference between the mechanical bore centers and the magnetic centers. The field characteristics, i.e., core saturation, fringing field distribution, effective length of magnet, harmonic contents and eddy current effects, were measured in pulsed excitation with a new measuring system using a peak-to-dc comparison method and a stepping search coil. (auth)

20472 EXPERIMENTAL STUDY OF THE RADIATION FIELD FROM PROTON LOSSES AROUND THE JINR SYNCHROPHASOTRON. Gvozdev, V. Ya.; Zaitsev, L. N.; Kolpakov, I. F.; Kryachko, A. P., Nikityuk, N. M.; Pavlov, N. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Particle Accel.; 4: No. 3, 129-144(Feb 1973).

It is shown that to determine the radiation field at an accelerator operating in the beam extraction mode, the azimuthal distribution of the proton loss must be known during acceleration and extraction. Integral detectors have been used previously for measuring only the total distribution function for the proton loss from internal targets. A system for monitoring the particle loss, consisting of 20 scintillation counters, scaling, and control equipment, was developed for the JINR proton synchrotron. The counters, arranged in a circular pattern near the vacuum chamber, record the flux of particles consisting primarily of protons and π mesons. After appropriate calibration it was possible to determine the absolute proton loss with a measurement error <20 per cent. The effect of the interceptor target for capturing secondary particles from the total distribution for the proton loss was studied to determine the location of the radiation sources. The source functions were determined from the distribution of the proton loss for different intensities and for different fractions of the extracted proton beam. These functions were used to calculate the radiation field around the proton synchrotron. (auth)

20473 SIMPLE MONITOR FOR BEAM-FOIL SPECTROSCOPY. Carriveau, G. W. (Univ. of Copenhagen). Nucl. Instrum. Methods; 107: No. 1, 195-196(15 Feb 1973).

A radiation monitor, used for normalization of spectral intensity measurements in beam-foil spectroscopy, has been constructed. This instrument uses a simple current-to-pulse converter in place of a commercial current digitizer. (auth)

20474 PHOTON DOSE RATES FROM THE INTERACTIONS OF 200-GeV PROTONS IN IRON AND IRON–LEAD BEAM STOPS. Gabriel, T. A.; Santoro, R. T. (Oak Ridge National Lab., TN). Particle Accel.; 4: No. 3, 169-186(Feb 1973).

The calculated photon dose rates from the long-lived ($\tau_{\frac{1}{2}} < 1$ min) photon- and positron-emitting radioactive nuclides produced when 200-GeV protons are incident on a semi-infinite cylindrical iron beam stop having a radius of 40.64 cm (16 in.) are compared with the calculated photon dose rates from long-lived photon- and positron emitting radioactive nuclides produced by 200-GeV protons in semi-infinite beam stops having a 30.48-cm (12-in.) radius iron core but surrounded by either 5.08 cm (2 in.) or 10.16 cm (4 in.) of lead. Data are also presented comparing the calculated photon dose rates from the long-lived photon- and positron-emitting radioactive nuclides produced when 200-GeV protons are incident on semi-infinite cylindrical iron beam stops having radii of 10.16 cm (4 in.), 20.32 cm (8 in.), 30.48 cm (12 in.), and 40.64 cm (16 in.). (auth)

20475 AUTOMATIC CORRECTION OF MAGNETIC FIELD HARMONICS IN MULTIPOLE PULSES IN SUPERCONDUCTING WINDINGS. Dael, A.; Kircher, F.; Pagot, J. (CEN, Saclay, France). Particle Accel.; 4: No. 3, 145-150(Feb 1973). (In French).

The theory of a selective correction of field harmonics which can be used in pulsed magnets is exposed. This correction made

of short-circuited superconducting windings and based on an inductive phenomenon can be particularly applied to superconducting pulsed multipoles. Its characteristic is to correct continuously, during the whole cycle, the unwanted field harmonic, whatever its origin is, except for the fringing field, of higher order. Experimental results are given, which confirm this principle in the correction of the sextupolar harmonic of a low field dipole. (auth)

Ion Sources and Injection and Extraction Systems

Refer also to abstract 20444.

20476 (IFVE-INZ-71-82) TV CONTROL SYSTEM FOR THE PREINJECTOR ION SOURCE OF THE I-100 LINAC. Mal'tsev, I. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 10p. (In Russian). INIS.

A two-channel system of remote control with light line coupling (light diode: photomultiplier) and thyristor circuit with channel separation of pulses is described. The system triggers two powerful thyristor modulators of a pulsed ion source with a frequency of up to 1 gHz and a relatively delayed startup within the limits of 0.5 to 5 msec. Light impulses were transmitted at a distance of 4 m across a 750 kV potential. Reliable operating time of the system was not less than 5000 hours under conditions of high interference levels. (tr-auth)

20477 (IFVE-INZ-71-83) POWER SUPPLY SYSTEM FOR THE PREINJECTOR ION SOURCE OF THE I-100 LINAC. Mal'tsev, I. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 12p. (In Russian). INIS.

A semiconductor circuit for supplying a duoplasmotron-type ion source with pulsed gas admission is described. The system assures a pulsed discharge current of up to 70 A and a pulse duration of 15, 30, and 50 used with a frequency of not more than 1 gHz. Reliable operating time of the system was not less than 5000 hours under conditions of high interference levels. Long-term stability of the supply voltage to the ion source was at least ±1%. (tr-auth)

20478 (JINR-P9-6880) BEAM EJECTION SYSTEM IN PHASOTRON WITH SPACE VARIATION OF MAGNETIC FIELD USING FERROMAGNETIC CHANNEL. Dmitrievskii, V. P.; Zaplatin, N. L.; Leshchenko, G. P.; Chesnov, A. F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

The results are presented of calculation of an ejection coefficient when using the ferromagnetic channel with stoking value of 3 cm. Calculation and experimental data on formation of peeler field, regenerator, and ferromagnetic channel are given. (auth)

20479 (KFK-1708) LAMBSHIFT TYPE POLARIZED ION SOURCE DESIGNED FOR THE ISOCHRONOUS CYCLOTRON IN KARLSRUHE. Bechtold, B.; Brueckmann, H.; Finken, D.; Friedrich, L.; Hamdi, K.; Strassner, G. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Nov 1972. 8p. Dep. NTIS (U. S. Sales Only).

One of the most favorable properties of Lamb-shift sources is to deliver intense beams with small emittance. Up to now they have been used to produce negatively charged proton or deuteron beams only. Extended studies of selective ionization of metastable atoms by charge exchange processes demonstrated the Lamb-shift source to be able to produce positively charged polarized beams also. The source described in detail is able to produce 500 nA transverse polarized deuteron beams within an emittance of less than 1 cm rad $eV^{\frac{1}{2}}$. The tensor polarization measured by neutron asymmetry of the $T(d,n)^4He$ reaction is $P_{33} = -0.73$. (auth)

20480 (KFK-1709) METHOD FOR PRODUCTION OF TRANSVERSE POLARIZED DEUTERON BEAMS IN A LAMB-SHIFT SOURCE USING STATIC MAGNETIC FIELDS. Bechtold, V.; Brueckmann, H.; Finken, D.; Friedrich, L.; Hamdi, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Nov 1972. 8p. Dep. NTIS (U. S. Sales Only).

A special arrangement consisting of two iron shielded solenoids was minimized in order to achieve intense metastable hydrogen atom beams with longitudinal polarization. A transverse polarization of the metastables is obtained by superposing the longitudinal magnetic field with a properly designed field in transverse direction. This whole set-up makes it feasible to ionize the metastables in the transverse magnetic field. The loss of the metastables by quenching in the transverse magnetic field can be avoided by electrical compensation. The measured transverse tensorpolarization was $P_{33} = -0.73$. (auth)

20481 (LA-5115, pp 63-66) RECENT MEASUREMENT OF THE ZGS INJECTOR BEAM CHARACTERISTICS. Parker, E. F. (Argonne National Lab., IL). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

Detailed measurements of the energy, energy spread and emittance as a function of time, rf level, preaccelerator high voltage and linac-debuncher relative phase have been made using a series of segmented Faraday cups recently installed in the Zero Gradient Synchrotron (ZGS). A strong energy dependence upon rf level and preaccelerator high voltage which has significant implications for the ZGS is found. (auth)

20482 (LA-5115, pp 126-130) BEAM PERFORMANCE OF THE SUPERCONDUCTING INJECTOR FOR THE STANFORD LINEAR ELECTRON ACCELERATOR. Suelzle, L. R.; Chambers, E. E. (Stanford Univ., CA). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

The testing and analysis of the injector for the Stanford superconducting linac indicates that a longitude space distribution with a phase spread of 1 degree FWHM and an energy spread 10 keV FWHM can be achieved. This would mean that a $\Delta E/E \leq 2 \times 10^{-4}$ FWHM could be achieved at 100 MeV for the linac. With the present capture section it would be necessary to increase the gun voltage to more than 120 kV in order to guarantee this performance for field gradients as low as 2.6 MV/m (0.8 MV/ft). For a $\beta_w = 0.95$ capture section operating at this field gradient, a 90 kV gun voltage would be adequate. The present gun system is capable of operating to approximately 100 kV. (auth)

20483 (LA-5115, pp 314-317) OPERATION OF THE LINAC-INJECTOR MODULATOR INTO A MISMATCHED LOAD. Bobylev, V. I. (Inst. of Theoretical and Experimental Physics, Moscow). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

The results of analysis of an artificial line modulator operating into a mismatched load with resistance less than the output resistance of the modulator are given. The analysis was carried out for three versions of modulator circuits: (a) and (b) corresponding to modulators with inverse voltage clipper and without one and (c) corresponding to a modulator with polarity reversal of inverse voltage. It is shown that the modulator with polarity reversal of inverse voltage has some positive features. Formulas for calculating the parameters of this type of modulator are given. (auth)

20484 (LA-5115, pp 356-357) SOURCE OF NEGATIVE IONS. Golubev, V. P.; Nalivaiko, G. A.; Tsepakin, S. G. (Scientific Research Inst. of Electrophysical Apparatus, Leningrad). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

Performance characteristics of a duoplasmatron H^- ion source are given and discussed. (WHK)

20485 (LA-5115, pp 365-370) PRELIMINARY TEST OF A NOZZLE TYPE PLASMA EXPANSION CUP. Kobayashi, M. (National Lab. for High Energy Physics, Oho-machi, Japan); Takagi, A.; Fukumoto, S.; Sluyters, T. J. M. Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10–13, 1972.

A nozzle-type plasma expansion cup having the throat aperture of 1.3 mmϕ was tested in order to improve the intensity and the emittance of the duoplasmatron beam. The maximum ion current was 800 mA at 60 keV with a normalized emittance of 0.35 cm · mrad. The high current at a relatively low arc current and low pressure indicates the nozzle-type plasma cup being promising. The observed aberration is discussed in relation to the plasma boundary distortion. (auth)

20486 ELECTRON GUN FOR A HIGH INTENSITY LARGE CROSS SECTION ABERRATION-FREE BEAM. Cortial, H. (to Commissariat a l'Energie Atomique). French Patent 2,114,205. 30 Jun 1972. Filed date 19 Nov 1970. 10p. (In French).

An electron gun designed for a Van de Graaff-type accelerator is presented. It consists of a cathode provided with an emitting

pellet and surrounded by a cylindrical conducting diaphragm maintained at the same potential as the cathode. The end of the cathode is in the form of a plane ring positioned in the same plane as the pellet. The focusing lens, which is axially movable, possesses a plane surface facing the cathode and parallel to the plane containing the emitting pellet and the outer surface of the diaphragm. (FR)

20487 DESIGN OF LOW DIVERGENCE ION SOURCE EXTRACTION SYSTEMS. Thompson, E. (Univ. of California, Livermore). Particle Accel.; 4: No. 2, 69-73(Dec 1972).

A simple design procedure for circularly symmetric ion source extraction systems is presented. The initial convergence of the extracted beam is balanced by the sum of the diverging action of the extraction electrode and the space charge repulsion in the beam itself. Also, the electrode shape necessary to give laminar flow in a spherically symmetric "Pierce geometry" is calculated. Finally the results of the calculations are found to be in good agreement with ion trajectories obtained using a numerical particle tracing code. (auth)

Ion Optics and Field Calculations

20488 (DESY-72/72) BUNCH LENGTHENING AND POWER LOSSES DUE TO THE VACUUM CHAMBER WALLS. Piwinski, A. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Dec 1972. 26p. Dep. NTIS (U. S. Sales Only).

The longitudinal field induced by a bunched beam in a metallic or ceramic vacuum chamber was investigated. The resulting power losses and the bunch lengthening was calculated for high energies and a limit for the stability of the phase oscillations was derived. (auth)

20489 (IFVE-OP-71-74) TRANSPORTING POLARIZED BEAMS OF CHARGED PARTICLES. Voronov, V. I.; Kartashev, V. P.; Rzaev, R. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 14p. (In Russian). INIS.

Experiments were conducted for the purpose of studying the spin dependence of proton interactions with polarized targets at high energies. Such experiments required polarized beams of protons, available from a 200 to 500 GeV accelerator. Three methods for obtaining high energy polarized beams of protons are discussed including the acceleration of polarized protons, polarization during elastic scattering, and polarized protons from the decay of hyperons. Problems in transporting polarized beams of charged particles are considered, and the conditions for maintaining the degree of polarization of the particles are examined. (tr-auth)

20490 (LA-5115, pp 119-121) FOCUSING BY LONGITUDINAL MAGNETIC FIELD IN A HIGH-ENERGY PROTON LINEAR ACCELERATOR. Bondarev, B. I.; Kushin, V. V.; Murin, B. P.; Solov'ev, L. Yu.; Fedotov, A. P. (Radiotechnical Inst., Moscow). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10-13, 1972.

In the main part (beyond 100 MeV) of a 600- to 1000-MeV ion linear accelerator, particle focusing can be achieved by means of superconducting solenoids. Expressions are presented that enable one to calculate parameters of a channel with sparse solenoids. This axially symmetrical focusing is shown to result in decrease of aperture and as a consequence in reduced rf power requirements. Superconducting solenoid focusing also leads to less stringent tolerances on channel parameters. (auth)

20491 (LA-5115, pp 131-139) BEAM BREAKUP IN A SUPERCONDUCTING ELECTRON ACCELERATOR. Mittag, K.; Schwettman, H. A.; Schwarz, H. D. (Stanford Univ., CA). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10-13, 1972.

Beam breakup problems encountered in the injector system of the superconducting electron linear accelerator at Stanford University are discussed. Topics include cumulative beam breakup, regenerative beam breakup, longitudinal beam breakup involving the TM_{01} modes, transverse beam breakup involving the HEM_{11} modes, passbands of the injector structures, experimental determination of starting currents, loading of breakup modes, and description of a band-stop filter. It was demonstrated that a beam intensity of 100 μA with a duty factor 1 can be achieved. (WHK)

20492 (LA-5115, pp 182-190) STATISTICAL BEAM TRANSPORT FOR HIGH INTENSITY ION CURRENTS. Emigh, C. R. (Los Alamos Scientific Lab., NM). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10-13, 1972.

One of the problems associated with the operation of a high-intensity 14-MeV neutron facility is that of transporting an ampere beam of tritium ions from the ion source to a small target area (1 cm^2). The intensity profile history of such an intense beam is difficult to predict correctly as it depends upon detailed knowledge of the nonlinearities in the system and a complete description of the individual particle trajectories, neither of which is sufficiently known. One way in which the beam characteristics may be described in sufficient detail to design completely a transport system to follow an intense beam through a nonrelativistic accelerator structure is described. The statistical beam transport is a rms average description in which the detailed charge distribution or particle velocity distribution need not be known. The size and growth of the beam is related to the rms values of both the positions and velocities of the individual particles. (auth)

20493 (LA-5115, pp 338-342) BEAM TRANSPORT DESIGN USING A THIN LENS APPROXIMATION. Chidley, B. G. (Chalk River Nuclear Labs., Ont.). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10-13, 1972.

The design of a beam transport system which will deliver a beam with a specified emittance profile is frequently troubled by lack of convergence of the beam transport calculation. A method is described which uses a thin lens approximation to find all solutions in the region of interest; these can then be used as approximate solutions for the more accurate thick lens calculation. A beam matching problem is equivalent to solving 4 non-linear equations in 4 unknowns. If the thin lens approximation is used these equations are polynomials and the problem can be reduced to finding the intersections of two 8th order equations. (auth)

20494 (LA-5115, pp 400-402) BASIC PROPERTIES OF THE SYMMETRIC INSERTION. Regenstreif, E. (Univ., Rennes, France). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In Proceedings of the 1972 proton linear accelerator conference, October 10-13, 1972.

Some analytical relations are given for a synchrotron insertion that leaves the linear orbit properties of the synchrotron invariant and yields a single unobstructed drift space containing nearly all of the available drift length in the insertion. (WHK)

20495 (LA-5115, pp 411-414) MEASUREMENT OF ION BEAM PHASE VOLUME. Solnyskhov, A. I.; Gerasimov, E. I.; Tarvid, G. V. (Scientific Research Inst. of Electrophysical Apparatus, Leningrad). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10-13, 1972.

The two- and four-slit methods for measuring phase density distributions of ion beams are discussed. (WHK)

20496 (LNF-72/56) USEFUL FORMULAS AND CALCULATED FUNCTIONS FOR THE "LUMINOUS" ELECTRON. Montelatici, V. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 14 Jun 1972. 38p. Dep. NTIS (U. S. Sales Only).

The emission of electromagnetic waves from an accelerated point electric charge is studied. The instantaneous angular distribution and average spectral distribution of the radiated energy, the asymptotic relation of the spectral distribution, and approximate relations of the Schott formula in the ultrarelativistic case are discussed. (JFP)

20497 (UCRL-Trans-1488) EFFECT OF ELECTRON-RING ACCELERATION ON FOCUSING BY IMAGING FORCES. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated for Univ. of California, Lawrence Berkeley Lab., Berkeley, from report JINR-P9-6421. May 1972. 12p. Dep. NTIS.

The focusing of the accelerated electron ring by the image forces in a perfectly conducting cylindrical screen is considered. The corrections to the focusing force induced by the acceleration are found, and their influence is analyzed. (auth)

20498 (UJF-2886-F) ELECTRIC FIELD OF THE DEE SYSTEM OF A CYCLOTRON. Kuemiak, M.; Grda, A.; Beishovets, V. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1972. 8p. (In Russian). Dep. NTIS (U. S. Sales Only).

One of the methods of determining the strength of the electric field of the dee system of the cyclotron is described. Formulas for formulating this strength make it possible to solve the equations of motion of the ions in the central region of the cyclotron. (tr-auth)

20499 INFINITE TRANSITION-ENERGY SYNCHROTRON LATTICE USING π-STRAIGHT SECTIONS. Teng, L. C. (National Accelerator Lab., Batavia, IL). Particle Accel.; 4: No. 2, 81-85(Dec 1972).

With reverse bends in a synchrotron lattice one can push the transition energy to infinity. It is shown that the same can be accomplished by judicious insertion of π-straight sections in a normal periodic lattice with finite transition energy and no reverse bend. (auth)

20500 LONGITUDINAL COUPLING IMPEDANCE OF A STATIONARY ELECTRON RING IN A CYLINDRICAL GEOMETRY. Faltens, Andris; Laslet, L. J. (Univ. of California, Berkeley). Particle Accel.; 4: No. 3, 151-157(Feb 1973).

The longitudinal (azimuthal) coupling impedance is investigated for a stationary electron-ring beam circulating between a co-axial pair of conducting tubes. Proximity of the beam to the inner tube is found to be advantageous for reducing $(|Z_n|/n)_{max}$. Similar results are shown to be attainable with operation near the outer tube provided the quality factors Q for higher-order resonant modes are deliberately made small. Illustrative computational results are presented graphically and a convenient approximate formula is suggested that may serve to guide the selection of desirable parameters for a typical fully-compressed electron ring. (auth)

Storage Rings

20501 (BNL-17589) IRON SATURATION AND SUPERCONDUCTOR MAGNETIZATION EFFECTS IN THE ISA MODEL BENDING MAGNET. Parzen, G.; Jellett, K. (Brookhaven National Lab., Upton, N. Y.). 22 Jan 1973. 7p. Dep. NTIS.

Computed results are presented for the iron saturation and superconductor magnetization effects in the ISA model bending magnet. (auth)

20502 (LA-5115, pp 279-282) LINAC-TYPE rf STRUCTURES FOR HIGH ENERGY STORAGE RINGS. Allen, M. A.; Wilson, P. B. (Stanford Linear Accelerator Center, CA). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10-13, 1972.

Structure design considerations and bandwidth requirements are discussed, and specific rf structure design examples are briefly described. (WHK)

20503 EFFECT OF RANDOM RF VOLTAGE FLUCTUATIONS ON A BUNCHED BEAM. Neil, V. K.; Cooper, R. K. (Univ. of California, Livermore). Particle Accel.; 4: No. 2, 75-79(Dec 1972).

The noise present in the driving current of the rf system for a storage ring will cause an increase in the average phase angle of protons stored in a bunched configuration. The rate of increase in the phase angle is calculated. Only small amplitude oscillations about the synchronous phase angle are considered. Results are given in terms of the signal-to-noise ratio (in power terms) of the cavity voltage, and indicate that the noise may be a stringent limitation on storage times unless the rf system is designed with care. (auth)

Experimental Facilities

Refer also to abstract 20496.

20504 (IAE-2095) SIMP PILOT INSTALLATION FOR EXPERIMENTS IN 7 GeV PROTON ACCELERATORS WITH THE USE OF 300 kG INTENSITY PULSED MAGNETIC FIELDS. Martem'yanov, V. P.; Ogurtsov, V. V.; Tarasenkov, V. G.; Khakimov, S. Kh. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 28p. (In Russian). INIS.

A description is given of the installation at the ITEF accelerator which was designed for experiments using a pulsed magnetic field. Tests were carried out to determine the magnetic moment Λ^* of the hyperon. In the process of exposure of the emulsion chamber a magnetic field of H = 220 kG was switched on ~70,000 times. (tr-auth)

20505 (LA-5115, pp 415-421) SOME HIGH RESOLUTION TECHNIQUES FOR USE WITH NEGATIVE ION BEAMS. Spencer, J. E.; Thiessen, H. A. (Los Alamos Scientific Lab., NM). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10-13, 1972.

The 800-MeV linac at LAMPF provides simultaneous beams of protons and negative hydrogen ions by accelerating separated bunches on successive half-wavelengths of the rf cycle. Use of the negative component provides some unique advantages for determining various experimental information as well as for beam diagnostic purposes. Some techniques which can be used to provide absolute determinations of the beam current and beam energy are described. Since the energy is constantly available during the course of an experiment, it can also be used as part of a feedback loop associated with either the experiments or with the rf cavities of the linac. A related discussion concerns techniques which rely on the negative ion beam for performing accurate experimental ray tracing at LAMPF energies. This can be a particularly useful tool for achieving optimal performance from very high resolving power systems. (auth)

20506 (LA-5115, pp 430-432) CEMENT POTTED COILS FOR MUON CHANNEL MAGNETS. Vogel, H. F.; Rosenthal, J. J. (Los Alamos Scientific Lab., NM). Nov 1972.

From Proton Linear Accelerator Conference; Los Alamos, New Mexico, United States of America (USA) (10 Oct 1972).

In proceedings of the 1972 proton linear accelerator conference, October 10-13, 1972.

The Stopped Muon Channel at LAMPF will be exposed to an intense flux of high energy neutrons. The first magnet is to be installed at a distance 60 cm from the source; the estimated radiation level for this magnet is 10^{10} to 10^{11} rads/year. The first four magnets of the channel utilize inorganic, radiation-resistant insulation materials. The conductor insulation consists of glass tape. An alumina-calcium aluminate composition is used for potting the coils and providing the ground insulation of these coils. These magnets are quadrupoles with 14 in. and with 12-in. bore, and a bending magnet with 11 in. gap dimension and 32 in. pole width. (auth)

20507 (LBL-1369) FIVE-TARGET MECHANISM FOR BERKELEY HILAC. Babin, A. (California Univ., Berkeley. Lawrence Berkeley Lab.). Dec 1972. Contract W-7405-eng-48. 12p. Dep. NTIS.

A mechanical device is described for holding five foil targets that may be separately inserted into the beam of a linear accelerator. The method of operation is graphically demonstrated. (auth)

20508 (SGAE-2050) SHIELDING CALCULATION FOR A 14 MeV NEUTRON GENERATOR. Eder, O. J.; Zwittlinger, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf, Physik-Institut). Oct 1972. 26p. (In German). Dep. NTIS (U. S. Sales Only).

The dangers in work with neutron generators are well known so that with adequate shielding and existing warning devices no radiation dangers exist. In accelerators which make necessary a target shifting there is a potential poison danger. This risk can, however, be controlled through ventilation, continuous measurement control, and decontamination. Typical calculations for each of these problem areas are given. (57 references) (tr-auth)

20509 TARGET CHAMBER FOR USE WITH RADIATIVE TRANSITION REACTIONS STUDIES. Hsu, T. H.; Tseng, P. K.; Lin, E. K.; Liu, Y. C. (Tsing Hua Univ., Hsinchu, Taiwan). Nucl. Instrum. Methods; 106: No. 3, 513-517(1973).

A target chamber with a continuously moving target holder was designed for the investigation of radiative transition reactions on the medium-weight nuclei. This chamber has been successfully used to gather data from the $^{70}Ge(p,\gamma)^{71}As$, $^{72}Ge(p,\gamma)^{73}As$, $^{65}Cu(p,\gamma)^{66}Zn$ and $^{27}Al(p,\gamma)^{28}Si$ reactions. Some of these results are presented and described. (auth)

20510 SOURCES OF POLARIZED NEUTRONS FROM 2 to 33 MeV USING POLARIZATION TRANSFER REACTIONS AT 0°. Simmons, J. E.; Broste, W. B.; Donoghue, T. R.; Haight, R. C.; Martin, J. C. (Los Alamos Scientific Lab., NM). Nucl. Instrum. Methods; 106: No. 3, 477-480(1973).

In the recent polarization transfer measurements at 0° for the $T(\vec{p},\vec{n})^3He$, $D(\vec{d},\vec{n})^3He$, and $T(\vec{d},\vec{n})^4He$ reactions, large neutron polarizations were measured. Because the reaction cross sections

are also large at this angle, the figures of merit for these reactions as sources of polarized neutrons are appreciably larger than for reactions initiated by unpolarized beams. Thus, polarization transfer reactions are new and important sources of polarized neutrons over most of the energy interval 2 to 33 MeV. Other significant advantages of these reactions are discussed. (auth)

20511 HIGH PROTON POLARIZATION IN 1,2-PROPANEDIOL AT ^{3}He TEMPERATURES. De Boer, W. (CERN, Geneva). Nucl. Instrum. Methods; 107: No. 1, 99-104(15 Feb 1973).

A study is made of the dynamic proton polarization in 1,2-propanediol doped with paramagnetic Cr(V) complexes. A method is described by which samples with a high concentration of Cr(V) complexes can be prepared. Samples of 1,2-propanediol prepared in this way yielded a maximum proton polarization of 92% at a temperature of 0.48 K in a 2.5 T magnetic field. The polarization build-up time was found to be 2 to 3 min in a 7 cm^3 sample, with about 25 mW microwave power in the cavity. The microwave power needed to maintain the polarization in such a sample was about 4 mW. (auth)

20512 TRANSFER SYSTEM ADAPTABLE TO A NEUTRON GENERATOR FOR SEQUENTIAL ACTIVATION ANALYSIS. Perdijon, J. (CEN, Grenoble, France). Nucl. Instrum. Methods; 107: No. 1, 189-191(15 Feb 1973). (In French).

A short review is given on the different options to take in order to constitute a transfer system for activation analysis with a neutron generator. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstracts 19917, 20593, 20653, 20676, 20786, 20847, and 21564.

20513 (AD-748614) OBSERVATIONS OF GALACTIC COSMIC RAY INTENSITY FROM 1.0 TO 2.0 A.U. HELIOCENTRIC RADIAL DISTANCE. Van Allen, J. A. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). 12 Aug 1972. Contract N00014-68-A-0196-0003. 12p. NTIS.

From observations with the Jupiter-bound spacecraft Pioneer 10 it is found that the integral intensity of the galactic cosmic radiation (E(p) > 80 MeV) varied by less than 3% (either + or −) over the heliocentric radial range 1.0 to 2.0 AU during the epoch March–July 1972. (auth) (NTIS)

20514 (AD-749672) INVESTIGATION OF THE ANISOTROPY OF HIGH ENERGY COSMIC RAYS IN CELESTIAL COORDINATES. Hearding, D. W. (United States Naval Academy, Annapolis, MD). 19 May 1972. 79p. (USNA-TSPR-29). NTIS.

In order to investigate the possible anisotropy of high energy cosmic rays of a preferred direction of arrival, a detector system—viewing the integral muon spectrum above 400 MeV—was developed. The detector system consisted of a sidereal mount with scintillation telescopes adjustable in declination and acceptance angle, and a monitor to indicate the effects of atmospheric variations on the count rate. Data was recorded from right ascension bins of two hours at a declination of 24, 39, and 54° north. It was determined that the detector system is a feasible and effective means of measuring the muon flux, and is currently being modified to detect stopping muons where the anisotropy has previously been observed. (NTIS)

20515 (CONF-710974–6) HIGH ENERGY PARTICLES IN COSMIC RAY SOURCES. Grewing, M. (Bonn Univ. (West Germany)). [nd]. 24p. (In German). Dep. NTIS (U. S. Sales Only).

From Autumn conference on high energy physics; Hamburg, Germany (13 Sep 1971).

The origin of high-energy particles in the cosmic radiation from supernovae, radiogalaxies, quasars, and pulsars is discussed. (JSR)

20516 GAMMA RAY ASTRONOMY AND COSMIC RAYS. Ginzburg, V. L. (Lebedev Inst. of Physics, Moscow). Usp. Fiz. Nauk; 108: No. 2, 273-283(Oct 1972). (In Russian).

The physics of gamma-ray astronomy and cosmic rays is reviewed, and the spectra of relativistic electrons, the energy density of cosmic rays, and the protons and nuclei which enter into the composition of cosmic rays are considered. The Magellanic Clouds and the central region of the Galaxy are discussed with respect to the possible diameters of the gamma sources present, the magnitudes of the photon fluxes, the Compton losses undergone by emitted electrons in strong fields, and the gamma-rays of "nuclear" origin, i.e., those rays formed by nuclear collisions of cosmic rays in a gas. (KSW)

20517 URANIUM DISTRIBUTION OF SOME MINERALS IN THE SIKHOTE–ALIN, GRESSK, AND ARUS METEORITES. Genaeva, L. I.; Kashkarov, L. L.; Lavrukhina, A. K.; Yukina, L. V. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Meteoritika; No. 31, 137-140(1972). (In Russian).

The microdistribution of U in the iron meteorites Sikhote–Alin, Gressk, and Arus was determined by the track method. Samples of minerals in contact with lavsan (an artificial fiber) were exposed to a flux of 10^{18} neutrons/cm^2. A track density of 10^3 cm^{-2} corresponded to a U concentration of 10^{-11} g/g. The U concentration in the three minerals kamacite, troilite, schreibersite was 3.9×10^{-11}, 4.7×10^{-10}, and 1.1×10^{-8} g/g, respectively, in the Sikhote–Alin meteorite, and similar values were observed in the Gressk and Arus meteorites. Average values from chemical composition and elemental distribution yielded 3.7×10^{-10} g/g as the U concentration in the Sikhote–Alin meteorite. (tr-auth)

20518 NATURE OF TRACKS IN OLIVINE FROM THE ILIMAEZ METEORITE. Kashkarov, L. L.; Lavrukhina, A. K.; Genaeva, L. I. (Inst. of Geochemistry and Analytical Chemistry, Moscow). Meteoritika; No. 31, 157-161(1972). (In Russian).

The natural tracks occurring in olivine crystals from Ilimaez pallasite were investigated in nearly 100 crystals removed from the meteorite at depths of from 0 to 14 cm. The variation in the density of short tracks (<15 μ) formed by Fe group nuclei ($22 < Z < 30$) with cosmic rays facilitated a determination of the depth of occurrence. Assuming a spherical form for the Ilimaez meteorite, the pre-atmosphere radius of the body was then calculated to be 27 cm, corresponding to a cosmic age of 5×10^7 yr. Track density for lengths >15 μ similarly yielded data on the $30 < Z < 40$ group of elements. The three-dimensional anisotropy of tracks confirmed their origin from heavier nuclei with primordial cosmic rays. (tr-auth)

20519 SIMPLE MONTE CARLO SIMULATION FOR SOLVING METHODOLOGICAL PROBLEMS OF DETECTING THE EXTENSIVE AIR SHOWERS ELECTRON COMPONENT. Stanev, T. (Physical Inst., Sofia). Comput. Phys. Commun.; 4: No. 1, 47-50 (Oct 1972).

A simulation of the EAS electron component is aimed at finding a criterion for dividing the showers into two groups according to their electron lateral spread. The same simulation can be used for a comparative investigation of the possibilities of different apparatus to detect multicored showers. (auth)

20520 SOME PHYSICAL APPLICATIONS OF THE SOLUTION OF ILL CONDITIONED SYSTEMS OF LINEAR EQUATIONS. Torsti, J. J.; Aurela, A. M. (Univ. of Turku, Finland). Comput. Phys. Commun.; 4: No. 1, 27-32(Oct 1972).

Various physical problems lead to an ill-conditioned system of equations $TX \approx U$ in which the variance–covariance matrix of the measured vector U is known. To facilitate the solution of such equations, a form of the quadratic optimization problem is introduced where the known constraints on the vectors X and L represent conventional bounding equations and boundary planes and a new type which cannot be expressed in the form of fixed boundaries. As the first application, experimental values of the multiple-scattering constant were calculated in the range 10 to 100 GeV/c from the preliminary data of the cosmic-ray muon spectrograph MARS in Durham, England. The results confirm the value 21 MeV of the constant. The form of the differential cosmic-ray muon spectrum at high energies was also analyzed on the basis of different measurements. As a second application, the method was used for solving the old inversion problem of the heat capacity of crystals. The method gave estimates for the frequency spectrum of lattice vibrations and for the anharmonic contributions to the specific heat in the cases of KCl and Cu, in qualitative agreement with the results obtained by other methods. (auth)

20521 ABUNDANCE PATTERNS OF THIRTEEN ELEMENTS IN PRIMITIVE CARBONACEOUS AND UNEQUILIBRATED ORDINARY CHONDRITES. Case, D. R.; Laul, J. C.; Pelly, I. Z.; (and others) (Purdue Univ., Lafayette, IN). Geochim. Cosmochim. Acta; 37: No. 1, 19-33(Jan 1973).

A neutron activation analysis technique was used to determine Au, Re, Co, Mo, As, Sb, Ga, Se, Te, Hg, Zn, Bi, and Tl in 11 carbonaceous chondrites, 12 unequilibrated ordinary chondrites (UCC), and 4 equilibrated ordinary chondrites. The first 6 elements are "undepleted," the next 3 "normally-depleted" and the last 4 "strongly-depleted." Except for Hg, "depleted-element" abundances in carbonaceous chondrites lead to mean relative ratios of C1 : C2 : C3 = 1.00 : 0.53 : 0.29, i.e., those predicted by a two-component (mixing of high-temperature and low-temperature fractions) model. The last 4 nominally "undepleted" elements are somewhat depleted in ordinary chondrites, As and Sb showing partial depletion in C3 and the latter in C2 chondrites as well. This requires a modification of the two-component model to indicate that deposition of elements during condensation of high temperature material was not an all-or-nothing process. Apart from Bi and Tl, the elements studied have similar abundances in unequilibrated and equilibrated ordinary chondrites and only the former are unquestionably correlated with the degree of disequilibrium in silicate minerals. Only some "strongly-depleted" elements exhibit at least one of the following—proportional depletion in UOC, progressive depletion in petrographic grades 3 to 6 ordinary chondrites and enrichment in the gas-containing dark portion of gas-rich, light-dark meteorites—indicating that such depletion does not ensure that an element will exhibit these trends. Partly or completely siderophile As, Au, Co, Ga, Mo, Re, and Sb vary with chemical type in the same manner in both unequilibrated and equilibrated ordinary chondrites and doubtless reflect a process involving fractionation of metallic iron. (auth)

20522 GEOCHEMICAL EVIDENCE FOR THE ORIGIN OF MOLDAVITES. Bouska, V. (Karlova Univ., Prague); Benada, J.; Randa, Z.; Kuncir, J. Geochim. Cosmochim. Acta; 37: No. 1, 121-131(Jan 1973).

Forty-eight moldavites and samples of rocks from the impact crater of Ries were analyzed using non-destructive neutron activa-

tion analysis. The following elements have been determined: La, Ce, Sm, Eu, Lu, Sc, Co, Cs, Hf, and Th; and Rb and Cr in two moldavites. The darker moldavites, more common in Moravia, show higher contents of trace elements than those lighter in color, from Southern Bohemia. Terrestrial igneous rocks cannot be regarded as a suitable source material, but terrestrial sandy to silty claystones show strong similarities in major and trace element abundances, and exhibit analogous inter-element variations to moldavites. The Tertiary claystones and sandstones, which probably covered the Ries area before the impact, are possible source rocks for moldavites. (auth)

20523 NOBLE GASES IN ELEVEN H-CHONDRITES. Ganapathy, R.; Anders, E. (Univ. of Chicago). Geochim. Cosmochim. Acta; 37: No. 2, 359-362(Feb 1973).

He, Ne, Ar, and Xe were measured in aliquots of 11 H-chondrites, to complement trace element studies on the same meteorites (Laul et al., Geochim. Cosmochim. Acta; 37: 329-357 (1973)). Bielokrynitschie, Charsonville, Pultusk and Supuhee have lost radiogenic gases before cosmic-ray exposure, and Doroninsk, during exposure. (auth)

20524 CHEMICAL FRACTIONATIONS IN METEORITES. 6. Accretion Temperatures of H-, LL-, and E-Chondrites, from Abundance of Volatile Trace Elements. Laul, J. C.; Ganapathy, R.; Anders, E.; Morgan, J. W. (Univ. of Chicago). Geochim. Cosmochim. Acta; 37: No. 2, 329-357(Feb 1973).

Extending earlier work on 11 L-chondrites, 9 volatile elements (Ag, Bi, Cs, In, Rb, Tl, Se, Cd, Zn) have been measured by neutron activation analysis in 11 LL- and 10 E-chondrites; the first 6 elements also in 22 H-chondrites. The observed fractionation patterns are consistent with theoretical condensation curves, and hence were apparently established during condensation from the solar nebula. Ordinary chondrites seem to have accreted between 420 and 500°K at $P \approx 10^{-5}$ atm; enstatite chondrites, at 450 to 520°K and $P \approx 5 \times 10^{-4}$ atm. The values for ordinary chondrites agree with O^{18}-based temperatures by Onuma et al. (Geochim. Cosmochim. Acta; 36: 169-188 (1972)), and with other characteristics such as Fe^{2+} content, presence of FeS, and absence of Fe_3O_4. A few detailed trends were noted. Seven of the 54 meteorites seem to contain small amounts of a material enriched in Ag, Bi, and especially Tl; possibly a late condensate from a region depleted in metal. Silver shows considerable scatter, which suggests inhomogeneous distribution in the meteorites. Xenon correlates with In approximately as expected for equilibrium solubility, with some differences (petrologic type 3; E-chondrites) attributable to mineralogical factors. Meteorites of higher petrologic types are slightly deficient in Xe, probably due to gas losses during metamorphism. Cesium also appears to have been redistributed during metamorphism. Various features of the two-component model are critically examined in the light of the latest evidence. Apparently this model still is an adequate approximation of reality. (auth)

20525 GALLIUM AND GERMANIUM IN THE METAL AND SILICATES OF L- AND LL-CHONDRITES. Chou, C. L.; Cohen, A. J. (Univ. of Pittsburgh). Geochim. Cosmochim. Acta; 37: No. 2, 315-327(Feb 1973).

Concentrations of Ga and Ge in the metal of 31 L-, 8 LL- and 2 H-chondrites, and in the silicates of 12 L- and LL-chondrites have been determined by spectrophotometric methods. The ranges of Ga contents in the metal of L- and LL-chondrites are 1.1 to 36.9 ppm and 1.0 to 34.1 ppm, respectively. The Ge content in the metal is positively correlated with Ga and ranges from 89.1 to 160 ppm, and 126 to 308 ppm for L- and LL-chondrites, respectively. The Ga content in the silicates of L-chondrites varies from 4.0 to 8.9 ppm. The Ga and Ge contents in the metal are clearly lower in unequilibrated than in equilibrated L- and LL- group chondrites. Unequilibrated (type 3 and 4) and equilibrated (type 5 and 6) chondrites are well separated in the plots of Ga vs Ge in the metal, and the L- and LL-groups are also well resolved. The Ga and Ge in the metal are well correlated with petrologic grade. This suggests that Ga and Ge variations in the metal are related to thermal metamorphism. There is evidence of an enrichment of Ga in the metal due to shock-reheating. (auth)

20526 FINE STRUCTURES OF MUTUALLY NORMALIZED RARE-EARTH PATTERNS OF CHONDRITES. Masuda, A. (Tokyo Univ.); Nakamura, N.; Tanaka, T. Geochim. Cosmochim. Acta; 37: No. 2, 239-248(Feb 1973).

REE abundances in ten chondrites (nine falls and one find) were determined very accurately by mass-spectrometric stable isotope dilution techniques. All of the chondrites have different relative and absolute REE patterns. Except for Eu and, rarely for Ce, the REE abundances in chondrites are smoothly fractionated from sample to sample. Notwithstanding differences in the abundances of common REE, four of five L6 chondrites have very similar absolute Eu abundances; their mutually-normalized REE patterns are not curved, but are composed of two rectilinear segments. The Leedey-normalized Ree pattern for St. Séverin (LL6) is composed of two concave curves. Yonozu's (H4,5) pattern shows negligibly concave curvature on both sides of Eu. Kesen's (H4) pattern is unusual in its overall pattern but also in irregularities for particular elements. The irregularity may be connected with the unusually high vapor pressure of metallic Yb. The REE pattern for the Allende bulk sample shows a discontinuity, presumably reflecting its considerable heterogeneity of composition and structure. It is evident that any pattern of ordinary chondrites cannot be produced from the Allende bulk pattern. A comparison is also made with the results on the chondrite composites previously investigated. (auth)

20527 INTER-ELEMENT RELATIONSHIPS BETWEEN TRACE ELEMENTS IN PRIMITIVE CARBONACEOUS AND UNEQUILIBRATED ORDINARY CHONDRITES. Kurimoto, R. K.; Pelly, I. Z.; Laul, J. C.; Lipschutz, M. E. (Purdue Univ., Lafayette, IN). Geochim. Cosmochim. Acta; 37: No. 2, 209-224 (Feb 1973).

The results of a search for significant (>95% confidence level) inter-element relationships among 13 trace elements in carbonaceous chondrites and 26 elements and the disequilibrium parameter for silicate phases in unequilibrated ordinary chondrites (UOC) indicate pronounced differences in the formation processes of these two sorts of primitive chondrites. Twenty-six pairs of elements are correlated in carbonaceous chondrites and these correlations lend support to a model involving mixing in different ratios of material differing in thermal history. Comparison of the 26 elements in UOC shows that 39 pairs of elements are significantly related and only very volatile elements are correlated with the disequilibrium parameter. Each of the inter-element relationships can be specifically ascribed to a metal-silicate fractionation in the solar nebula or to a thermal fractionation. These relationships are about equally consistent with the metamorphism, two-component condensation and simultaneous accretion-condensation models for the origin of the ordinary chondrites, each requiring adoption of specific ad hoc assumptions for complete consistency. (auth)

20528 INVESTIGATION OF HEAVY PRIMARY PARTICLES IN COSMIC RADIATION (WITH PLASTIC DETECTORS). Beaujean, R. Atomkernenergie; 20: No. 3, 235-238(Dec 1972). (In German).

Investigations on the heavy particles of cosmic radiation were divided into three categories: charge and isotope frequencies in the charge range Z = 4 to 8 with cellulose nitrate as the detector, charge spectra in the range Z = 12 to 28 with Lexan polycarbonate as the detector, and frequencies of the very heavy particles with atomic number over 30. The results of these measurements are shown graphically. (J.S.R.)

20529 SEA LEVEL COSMIC RAY MUON SPECTRUM ABOVE 200 BeV. LaMay, L. J. San Diego, CA; Univ. of California (1972). 227p. University Microfilms Order No. 734421.

Thesis (Ph. D.).

The energy dependence of the cosmic-ray muon spectrum was measured for nine zenith angles between 0° and 90° for 14,942 muons above 200 BeV. The spectrum was measured with a magnetic spectrometer having a maximum detectable momentum of 3000 BeV/c. The energy dependence of the muon spectrum between 0° and 60° was fit to the anomalous "X-peak" production of muons proposed by the Utah group, and was found to be in better agreement with the conventional production of muons by pion and kaon decay. (Diss. Abstr. Int., B)

20530 $^{40}Ar-^{39}Ar$ CHRONOLOGY OF FOUR CALCIUM-RICH ACHONDRITES. Podosek, F. A.; Huneke, J. C. (California Inst. of Tech., Pasadena). Geochim. Cosmochim. Acta; 37: No. 3, 667-684(Mar 1973).

Results are presented from thermal-release $^{40}Ar-^{39}Ar$ dating experiments on four calcium-rich achondrites. Pasamonte shows an apparent age of 4.1 AE (1 AE = 10^9 yr) over 70% of its gas release indicating a degassing event at this age. At higher temperatures, the apparent age for Pasamonte rises to 4.51 AE, defining a lower limit gas retention age which is identical to that of the chondrites St. Severin and Guareña. Petersburg has a a high-temperature gas retention age of 4.40 ± 0.03 AE, 100 million years younger than St. Severin, in agreement with previously reported Pu-Xe and K-Ar gas retention ages and the absence of ^{129}Xe from the decay of ^{129}I. Stannern has a complicated pattern of apparent age with gas release which cannot be accounted for in detail by simple diffusive loss following a well-defined initiation of gas retention. In broad scale, however, the

Stannern pattern is relatively flat and confined to the range 3.5 to 3.9 AE, indicating that this meteorite was strongly degassed in this interval. The nakhlite Lafayette has an exceedingly young gas-retention age in the range 1.4 to 1.7 AE. These results indicate that as a group the calcium-rich achondrites have experienced a more diverse and extensive thermal history than have the chondritic meteorites. (auth)

20531 NORTH-SOUTH ASYMMETRY IN THE INCREASE OF COSMIC-RAY INTENSITY BEFORE MAGNETIC STORMS. Kaminer, N. S.; Kashevarov, V. P.; Kuz'micheva, A. E.; Dorman, L. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 343-347(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 385-391(1972).

The north–south asymmetry of the increase is investigated. The dependence of the expected north–south asymmetry on the distance of the region of effective quasi-spherical shock wave generation from the Sun is computed on the basis of model representations. A comparison of the results with experimental data shows that quasispherical shock waves are generated at a distance of ~0.3 AU from the Sun. It is demonstrated that in some cases data on the north–south asymmetry of the increase permit identifying the chromospheric flare responsible for a given Forbush effect. (auth)

20532 SOME ASPECTS OF MEASURING THE DIFFERENTIAL COSMIC RAY SPECTRUM. Kolchin, A. A.; Lebedev, V. V.; Skrebtsov, G. P. (Physical-Technical Inst., Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 348-352(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 392-397(1972).

The factors affecting the measurement accuracy of cosmic-ray particles when particle fluxes are recorded in several given energy intervals are investigated. It is shown that sometimes it is impossible to use such an instrument characteristic as the geometric factor. A general approach to the computation of the characteristic of an instrument designed to obtain differential cosmic-ray spectra is described. (auth)

20533 27-DAY VARIATIONS OF COSMIC-RAY ANISOTROPY. Shatashvili, L. Kh.; Pankratov, A. K.; Stepanyan, A. A. (Inst. of Geophysics, Tbilisi, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 476–478(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 538-540(1972).

The diurnal cosmic-ray anisotropy and its variations with the period of solar rotation was determined using a method proposed by Stepanyan, 1962. The anisotropy was determined from data of stations with similar cosmic-ray cutoff rigidities, located at different longitudes, from July 1957 to February 1958. In determining the 27-day variations of anisotropy the angle of particle drift in the geomagnetic field was taken into account. Therefore, the harmonic coefficients define the diurnal cosmic-ray anisotropy beyond the magnetosphere. (JCW)

Stars

20534 STUDY OF RELATIVE STELLAR ORBITS IN CLUSTERS. I. Dzigvashvili, R. M. Byull., Abastumanskaya Astrofiz. Observ., Akad. Nauk Gruz. SSR; No. 40, 101-122(1971). (In Russian).

Analysis of the relative orbits of stars in clusters NGC 5460, 5617, 6067, 6405, and 6494. Expressions are given for the gravitational potential of the clusters, for the orbital elements and motion of a star in a cluster, and for the anomalistic period in the plane orbit of a cluster star. It is shown that the force of gravity in these clusters increases rapidly with the distance from the cluster center, from zero at the center to a maximum at about 1 pc from the center, and then tends asymptotically to zero as the distance approaches infinity. It is also found that the circular velocities of stars in these clusters increase linearly over a distance of 1 pc from the cluster center and then begin to decrease at slow rates. (IAA)

20535 GRAVITATIONAL COLLAPSE WITH A PHYSICAL SINGULARITY ON AN ISOTROPIC HYPERSURFACE. Pinus, V. K.; Frenkel, A. L. (Siberian Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Irkutsk, USSR). Zh. Eksp. Teor. Fiz.; 64: No. 1, 43-47(Jan 1973). (In Russian).

A special class of solutions of the Einstein equation is found for the case of "gravitational collapse" of a central-symmetric distribution of matter with an ultrarelativistic equation of state. The collapse hypersurface in these solutions is isotropic whereas in the "general" solution of the present problem the singularity occurs on a space-similar hypersurface. (auth)

20536 AMPLIFICATION OF WAVES REFLECTED FROM A ROTATING BLACK HOLE. Starobinskii, A. A. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 1, 48-57(Jan 1973). (In Russian).

Amplification of waves reflected from a rotating black hole was investigated. The process involves the extraction of energy and momentum from the black hole. Conditions for existence of the effect were determined. The amplification factor was determined for the model case of scalar waves. Partial cross sections for wave capture by a black hole were calculated for waves with frequencies which do not satisfy the existence condition. (auth)

20537 EXACT POSITION CATALOG FOR FORTY-TWO NOVAE. Khatisov, A. Sh. Byull. Abastumanskaya Astrofiz. Observ., Akad. Nauk Gruz. SSR; No. 40, 13-28(1971). (In Russian).

Tables of exact positions are given for a group of 42 novae. The positions were determined on the 70-cm meniscus telescope of the Abastumani Observatory. Yale Observatory and AGK2 catalog data were used for the reference stars. The data reduction was made by the Turner and Schlesinger method. Maps of neighborhoods of the novae are given. (IAA)

20538 FEATURES OF PHOTOELECTRIC BRIGHTNESS VARIATIONS IN THE ECLIPSING VARIABLE EQ TAURUS. Magalashvili, N. L.; Kumsishvili, Ya. I. Byull., Abastumanskaya Astrofiz. Observ., Akad. Nauk Gruz. SSR; No. 40, 3-12(1971). (In Russian).

The results of photoelectric observations of EQ Taurus are discussed. The observations were carried out from December 1968, through December 1969, on an AZT-14A telescope with an AFM-6 electrometer. An antimony-cesium photocathode was used as the photoreceiver. Five moments of minima were determined and were used to improve the results of measurements. (IAA)

20539 STUDY OF CARBON STARS BY COMPARING THE R–N AND C CLASSIFICATION SYSTEMS. Dolidze, M. V. Byull., Abastumanskaya Astrofiz. Observ., Akad. Nauk Gruz. SSR; No. 40, 29-38(1971). (In Russian).

The properties of red carbon stars, blue carbon stars, and carbon stars with color ratio anomalies in the spectrum are inferred from a comparative analysis of the R-N and C classifications. The diversity of typical individual stars of these classes is noted. A table of spectral characteristics is given for 16 carbon stars. (IAA)

20540 EVOLUTION OF POPULATION II STARS. Davis Philip, A. G. (ed.). Dudley Observatory Report No. 4. Albany; Dudley Observatory (1972). 222p. (CONF 701234–). $3.12.

From The Evolution of Population II Stars Conference; Stony Brook, New York, United States of America (USA) (3 Dec 1970).

Eighteen papers were presented at the two day conference on Population II stars. This volume contains sixteen of the papers, but does not include the discussions. (WDM)

20541 ACTIVITY IN FLARE STARS OF THE SOLAR NEIGHBORHOOD. Kunkel, W. E. Astrophys. J., Suppl. Ser.; 25: No. 213, 1-36(Jan 1973).

Activity of flare stars in the vicinity of the Sun is compared in terms of a set of descriptive parameters that minimize problems of bias and noise in measurement. From an examination of U-band observations of about 1000 flares obtained at the McDonald and Cerro Tololo Observatories between 1966 and 1970 it was found that: (a) The distribution of flare amplitudes follows an exponential. (b) Flare durations are greater on stars of higher luminosity, confirming the result of Haro and Chavira. (c) Flare durations show considerable spread. (d) Incompleteness in sampling is severe. (e) Neither the mean duration of flares nor the dispersion in duration is variable in time. (f) By accepting certain assumptions on flare incidence in the unobservable domain, up to 1 percent of stellar energy sources is expended in flare activity (assuming hydrogen recombination), irrespective of stellar luminosity. (g) Other than this upper limit, no relation exists between a star's level of activity and its luminosity. Stars of comparatively low but nonzero activity are found at all luminosities. (auth)

20542 NEUTRINO THERMAL CONDUCTIVITY IN COLLAPSING STARS. Imshennik, V. S.; Nadezhin, D. K. (Inst. of Applied Mathematics, Moscow). Zh. Eksp. Teor. Fiz.; 63: No. 5, 1548-1561(Nov 1972). (In Russian).

Gasdynamic calculations of gravitational collapse of stars show that: 1) the collapse dynamics to a large extent is determined by neutrino emission processes, the main role being played by the URCA-process; 2) at a certain stage of collapse the central nucleus of the star becomes opaque with respect to its own neutrino radiation. Neutrino (and antineutrino) energy and momentum transfer processes are considered and incorporated into gasody-

namics. The neutrino gasodynamics equation set is derived in the thermal conductivity approximation which extends the photon radiative thermal conductivity familiar from radiative gasodynamics. An additional diffusion equation for lepton charges is obtained which follows from an analysis of β-interaction kinetics in a medium of arbitrary nuclear composition. All transfer coefficients are calculated for the case of high temperatures when the baryon component of matter consists of free nucleons. A spherically symmetric boundary problem for the central nucleus of a star is formulated. (auth)

20543 COMPACT BINARY STARS AND THEIR SIGNIFICANCE IN THE THEORY OF STELLAR EVOLUTION. Martynov, D. Ya. Usp. Fiz. Nauk; 108: No. 4, 701-732(Dec 1972). (In Russian).

This review discusses double stars with regard to the physical characteristics of their components, mass ratios, angular velocities, etc. Changes in the orbits of a compact pair, length of the period, orbital moments of impulse, and stellar evolution are examined. Additional sections focus attention on novae, black holes, and the internal structure of a star as derived from data on compact doubles. (KSW)

20544 LkHα 101: NOT A NORTHERN ETA CARINAE? Allen, D. A. (Royal Greenwich Observatory, Herstmonceux Castle, Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 1, 1P-2P(1973).

It has been reported that the spectrum of LkHα 101 in the photographic infrared resembles that of η Carinae. At visible wavelengths the spectrum is found to be much less remarkable. (auth)

20545 STATISTICAL LINE BLANKETING IN ARCTURUS. I. Blanketing-Coefficient Description of Observations. Edmonds, F. N. Jr. (Univ. of Texas, Austin). Publ. Astron. Soc. Pac.; 85: No. 503, 24-41(Feb 1973).

A statistical description of line blanketing is presented for Arcturus (α Boo, K2 IIIp, V = +0.06) which is based on equivalent widths and identifications of roughly 10,000 spectral lines within the wavelength region $\lambda\lambda$3600 to 25,000 Å. Equivalent-width contributions or blanketing coefficients for lines grouped as to equivalent width and identification are given for 100 Å wavelength intervals for λ < 9000 Å and 500 Å intervals for λ > 9000 Å. Strong lines are listed individually, and the variation or scatter of blanketing within intervals is described. Corrections to this description for limitations in the observations and their analysis are discussed. (auth)

20546 SOME VARIABLES OF SPECTRAL TYPE K. Eggen, O. J. (Australian National Univ., Canberra). Publ. Astron. Soc. Pac.; 85: No. 503, 42-56(Feb 1973).

(UBVRI) photometry for 22 variables of spectral type K are presented, including one new variable (HD 81410) and two previously suspected variables (HD 118238, HD 25966). Seven of the stars show no variation (HD 25966, CK Ori, IU Ori, U Pyx, RX Vir, N Vel, V418 Cen) and several have been misclassified—the outstanding case of misclassification is S Cae, catalogued as a K-type variable with a period near 100d, it appears to be an A-type variable with a period less than one day. Spectra are needed for several stars including EW Sct, a possible Cepheid with a period of 10 or 11 days. Six candidates for red variables of the halo population include UY Psc, VW Eri, RX Ret, V Pyx, V 520 Oph, and TU Cap. (auth)

20547 ζ^1 SCORPII: A VARIABLE SPECTRUM SUPERGIANT. Jaschek, M.; Jaschek, C. (Observatorio Astronomico, La Plata). Publ. Astron. Soc. Pac.; 85: No. 503, 127-130(Feb 1973).

Very conspicuous and unexpected variations in the strength of lines belonging to different elements are reported on the basis of 42 Å mm^{-1} spectrograms taken between 1965 and 1970. The variations involve principally He I, N II, and O II. The observations suggest a very turbulent state of the outer layers of this star which is probably connected with mass loss from the surface. (auth)

20548 UBV PHOTOMETRY OF ζ AURIGAE AND 31 CYGNI. Lovell, L. P. (Hickox Observatory, Chagrin Falls, OH); Hall, D. S. Publ. Astron. Soc. Pac.; 85: No. 503, 131-132(Feb 1973).

Differential UBV observations of ζ Aur and 31 Cyg, 28 of the former and 36 of the latter, were obtained shortly before and during their recent 1971-72 eclipses. (auth)

20549 DIFFERENTIAL UBV PHOTOMETRY OF β LYRAE. III. Landis, H. J.; Lovell, L. P.; Hall, D. S. Publ. Astron. Soc. Pac.; 85: No. 503, 133-138(Feb 1973).

As part of a continuing program of systematic photometry of β Lyrae, 151 differential BV observations and 130 differential UBV observations were obtained in 1971 at three observatories. (auth)

20550 REDDENING OF NOVA FH SERPENTIS 1970. Hutchings, J. B.; Fisher, W. A. (Dominion Astrophysical Observatory, Victoria, British Columbia). Publ. Astron. Soc. Pac.; 85: No. 503, 122-126(Feb 1973).

Measurements of the diffuse interstellar lines at $\lambda\lambda$5780, 5796 in the early postmaximum spectra of nova FH Ser indicate a value of $E_{B-V} \sim 0.90$. Spectroscopic observations are pointed out, which add support to the suggestion that considerable local reddening occurred during the deep transition stage of the nova. (auth)

20551 MINIMUM EACH FOR GL CARINAE AND SV CENTAURI. Landolt, A. U. (Louisiana State Univ., Baton Rouge). Publ. Astron. Soc. Pac.; 85: No. 503, 117-118(Feb 1973).

A time of minimum light is given for GL Car at primary eclipse, and for SV Cen at primary eclipse. (auth)

20552 VARIABLE 39 IN IC 1613. Hutchinson, J. L. (Univ. of Wisconsin, Madison). Publ. Astron. Soc. Pac.; 85: No. 503, 119-121(Feb 1973).

A study of the variability of variable 39 in IC 1613 was undertaken using data in Sandage's paper (1971). Except for an apparent luminosity discrepancy the data seem to be consistent with the identification of this star as a W Vir star, modulated over a time scale about 1000 days. (WDM)

20553 IMPROVED ELEMENTS FOR THE HYADES GROUP BINARY 43 PERSEI. Wallerstein, G. (Univ. of Washington, Seattle). Publ. Astron. Soc. Pac.; 85: No. 503, 115-116(Feb 1973).

New orbital elements from 14 high-dispersion spectrograms were derived for this double-line binary of type F5. The orbital elements were combined with the absence of an eclipse to derive minimum masses of 0.94 $M_\odot$ and 0.89 $M_\odot$ which are consistent with either the Sun–Sirius mass-luminosity relation or Eggen's mass-luminosity relation for the Hyades. (auth)

20554 LUNAR OCCULTATIONS FROM CERRO TOLOLO. I. The Carbon Star, TX Piscium. Lasker, B. M.; Bracker, S. B.; Kunkel, W. E. (Cerro Tololo Inter-American Observatory, La Serena, Chile). Publ. Astron. Soc. Pac.; 85: No. 503, 109-111 (Feb 1973).

Observations from a lunar occultation of the carbon star, TX Psc, give a diameter of 0.009 ± 0.001 for a uniformly illuminated disk. This diameter and Eggen's (1972) photometric parameters imply a radius of 120 $R_\odot$ or an effective temperature of 3140°K. (auth)

20555 NEW PHOTOMETRIC ELEMENTS OF THE ECLIPSING BINARY X TRIANGULI. Shaw, J. C.; Kusler, K. L. (Univ. of Georgia, Athens). Publ. Astron. Soc. Pac.; 85: No. 503, 112-114 (Feb 1973).

Photographic observations by Jordan (1929) and visual measures by Dugan (1928) of X Tri are reanalyzed using the Russell model and partial limb darkening. Probable sizes and masses of both components are presented. The system is typical of semidetached systems. (auth)

20556 LUMINOSITY FUNCTIONS FOR K GIANT STARS DERIVED FROM THE TWO-MICRON SKY SURVEY. Hughes, E. E. Jr. (Pomona Coll., Claremont, CA). Publ. Astron. Soc. Pac.; 85: No. 503, 57-67(Feb 1973).

A method is presented for determining either the space density or the luminosity function from star counts covering large areas of sky. Space density is assumed to vary only in the direction perpendicular to the galactic plane. The method extends that derived for use with the star counts in the Selected Areas by allowing for an integration over a wide and continuous range of galactic latitudes, and is, therefore, applicable to surveys where the number of stars per square degree is small but the area surveyed is an appreciable fraction of the sky. The catalog (IRC) produced from the 2-micron sky survey at Caltech is such a survey. Application of the method to a selection of IRC stars dominated by K giants shows that if these stars obey Oort's determination of their normalized space density perpendicular to the galactic plane then the dispersion σ of their 2.2 μ luminosity distribution must be large, i.e., on the order of ±1.0 m within a single spectral subtype. This result is in accord with conclusions recently set forth by Jung. (auth)

20557 POSSIBLE HORIZONTAL-BRANCH STARS AT HIGH GALACTIC LATITUDES. VI. Davis Philip, A. G. (State Univ. of New York, Albany). Publ. Astron. Soc. Pac.; 85: No. 503, 68-69(Feb 1973).

Positions, B magnitudes, and spectral types are given for ten new possible field horizontal-branch stars in two regions, the north and south galactic poles. (auth)

20558 FINDING LIST OF FAINT UV-BRIGHT STARS IN THE GALACTIC PLANE. Lanning, H. H. (Carnegie Institution of Washington, DC). Publ. Astron. Soc. Pac.; 85: No. 503, 70-84 (Feb 1973).

Eighty-two uv-bright stars were found on 17 two-color 48-inch Schmidt plates centered on the galactic plane, and on one high-latitude plate. The sources were divided into three categories according to their apparent (U−B) values: (a) sources bluer than (U−B) ≃ −0.8, (b) sources bluer than (U−B) ≃ −0.5 but redder than (U−B) ≃ −0.8, and (c) marginal sources bluer than (U−B) ≃ −0.3 but redder than (U−B) ≃ −0.5. Some of the most prominent sources are discussed, and finding charts are included for all sources listed. (auth)

20559 UBV-PHOTOMETRY OF SELECTED AP STARS. Huchra, J.; Willner, S. P. (Carnegie Institution of Washington, DC). Publ. Astron. Soc. Pac.; 85: No. 503, 85-86(Feb 1973).

UBV photometry is presented for 24 Ap stars which either were previously unmeasured or are suspected to be variable. (auth)

20560 EXTINCTION CURVE FOR CYGNUS OB2 NO. 12. Chaldu, R. (Indiana Univ., Bloomington); Honeycutt, R. K.; Penston, M. V. Publ. Astron. Soc. Pac.; 85: No. 503, 87-90 (Feb 1973).

An extinction curve is presented for the star Cygnus OB2 No. 12 derived from scans of this star and less highly reddened stars of similar spectral types. Possible new diffuse interstellar bands are found. The extinction curve resembles that found elsewhere in Cygnus for $1/\lambda < 2.5$ micron^{-1} except that the absorption "bump" near $1/\lambda = 2.05$ micron^{-1} is absent. (auth)

20561 SPECTRAL OBSERVATIONS OF SOUTHERN PLANETARY NEBULAE. I. Ringuelet, A. E. (Observatorio Astronomico, La Plata); Mendez, R. H. Publ. Astron. Soc. Pac.; 85: No. 503, 96-98(Feb 1973).

Spectra of eight planetary nebulae are described in the region λ3400 to λ7200. (auth)

20562 PLANETARY 292 + 1°1. Ringuelet, A. E. (Observatorio Astronomico, La Plata); Mendez, R. H. Publ. Astron. Soc. Pac.; 85: No. 503, 99(Feb 1973).

A brief note on the spectral characteristics of the planetary 292 + 1°1 is presented. (WDM)

20563 SPATIAL DISTRIBUTION OF THE 11.7 MICRON RADIATION OF NGC 7027. Knacke, R. F. (State Univ. of New York, Stony Brook); Dressler, A. M. Publ. Astron. Soc. Pac.; 85: No. 503, 100-102(Feb 1973).

The planetary nebula NGC 7027 was observed at 11.7 μ with a spatial resolution of 4 arc seconds. The infrared radiation is generally correlated with the Hα and radio fluxes indicating that the thermal emission is from hot grains within the ionized regions of the nebula. (auth)

20564 REALITY OF MICROTURBULENCE. Worrall, G. (Cambridge Univ., Eng.). Nature (London) Phys. Sci.; 241: No. 105, 7(1 Jan 1973).

Comments are offered on the discussions by Pagel at the Institute of Physics meeting on atomic and molecular physics, University of Sussex, April, 1972, on the reality of microturbulence in stellar atmospheres and the assumption of local thermodynamic equilibrium (see also Nature Phys. Sci. 237: 49 (1972) and Nature 236: 9 (1972)). Local thermodynamic equilibrium is considered to be an inadequate assumption for analyzing stellar spectral lines; observations are clearly inconsistent with this assumption. (UK)

20565 RECENT SUPERNOVA IN NGC 5253 AND THE SUPERNOVA RATE. Wamsteker, W. (Univ. of Arizona, Tucson); Wisniewski, W.; Lee, T. A.; Wdowik, T. J. Nature (London) Phys. Sci.; 241: No. 105, 7-9(1 Jan 1973).

Some interesting aspects of the bright supernova SN 1972e, in NGC 5253, are discussed, and some ideas are given concerning the supernova production rate. The probable consequence of a supernova event is the formation of a remnant energized by a rapidly rotating neutron star in a manner similar to that of the Crab Nebula and its pulsar, and the characteristic power law spectrum of the Crab Nebula continuum suggests the possibility of detecting such a phenomenon in the SN 1972e event. A power law spectrum for SN 1972e is not obvious from visual photometry but measurements at 1.25 and 2.2 μm indicate a continuum that might be expected to originate in the superposition of a thermal emission, peaking in the visual region, on a negative index power law spectrum. Assuming that the electromagnetic energy partition is similar to that occurring in the Crab Nebula, an expression is derived for the expected flux from synchrotron emission of a supernova remnant in NGC 5253, and results suggest that synchrotron emission could be the source of the observed 2.2 μm radiation from SN 1972e. It is suggested that NGC 5253 and NGC 5236 are probably a physical pair. Four supernovae are known to have exploded in NGC 5236, while two have been observed in NGC 5253, and this large number (six in 77 years) prompted the investigation of supernova production rates. Among conclusions reached is that the chances of supernova detection are strongly dependent on morphological type. (UK)

20566 OPTICAL CIRCULAR POLARIZATION OF X PERSEI. Stokes, R. A.; Avery, R. W.; Michalsky, J. J. (Battelle Northwest, Richland, Wash.). Nature (London) Phys. Sci.; 241: No. 105, 5(1 Jan 1973).

It is stated that the possible identification of X Per with the x-ray source 2 ASE 0352 + 30 has aroused interest in other properties of the star. X Per was observed on six nights in September and October 1972 with the Battelle 31 inch reflector and a polarimeter utilizing a birefingence modulator. The system also utilized a photon counting synchronous detection systems that allowed obtaining polarization data independent of atmospheric extinction fluctuations. Initial observations were made using wide-band astronomical colour filters. Stokes parameters are tabulated. It is not clear from the data whether the observed polarization was intrinsic to the star or the result of processes in the interstellar medium or even a circumstellar cloud. The data indicate polarization of the same magnitude, 0.01%, in the B and V filters, with no polarization greater than 0.005% in the red. Further observations with narrow band filters are planned to determine the dependence of polarization upon wavelength and to check on source variability. (UK)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 20516 and 20654.

20567 (AD-749771) PERIODIC MEASUREMENTS OF THE INTEGRATED STOKES PARAMETERS OF COMPACT RADIO SOURCES. Berge, G. L.; Seielstad, G. A. (Owens Valley Radio Observatory, Pasadena, Calif.). 1972. Contract N00014-67-A-0094-0019. 27p. NTIS.

The complete state of the integrated radiation from several compact radio sources was measured at three frequencies and at several epochs: 1420 MHz (1971.0), 1602 MHz (1971.1), and 5000 MHz (1971.5, 1971.8, 1972.0). The latter represents the beginning of a program that is still in progress, to monitor selected sources periodically at 5000 MHz. Although the authors were primarily interested in circular polarization, all four Stokes parameters were, in fact, obtained, and all of the results are presented herein. (auth) (NTIS)

20568 (AD-749772) INTERFEROMETRIC OBSERVATIONS OF FORMALDEHYDE ABSORPTION IN FRONT OF STRONG GALACTIC SOURCES. Fomalont, E. B.; Weliachew, L. (Owens Valley Radio Observatory, Pasadena, Calif.). 1972. Contract N00014-67-A-0019. 35p. NTIS.

Observations were made of formaldehyde absorption at 4830 MHz in front of Sgr A, Sgr B2, W3, NGC 2024, W31, W33, W43, W49A, and W51. The California Institute of Technology interferometer, consisting of two 90-foot paraboloids, was used to synthesize a beam of 40 × 60 sec Δl where Δ is the source declination and l = 38°. The main absorption features show variations of optical depth over the sources but there is no significant clumping. (auth) (NTIS)

20569 APPLICATION OF THE MONTE CARLO METHOD TO THE CALIBRATION OF DETECTORS FOR GAMMA-RAY ASTRONOMY. Wills, R. D. (European Space and Tech. Centre, Noordwijk, Netherlands). Comput. Phys. Commun.; 4: No. 1, 51-58(Oct 1972).

The interpretation of the results of experiments in cosmic-ray and space physics is dependent on a good understanding of the performance of the instrumentation. Such a calibration may be obtained by use of an artificial stimulus, such as a beam of charged particles from an accelerator. The practical difficulties of such an approach, especially where the time scale is tied to the schedule of a satellite project, indicate the value of a theoretical estimation of the detector response. Since the particle interaction processes are of a statistical nature it is not usual to obtain analytical solutions to the problem. Instead a Monte Carlo technique is frequently employed in which the behavior of individual particles is determined by randomly selected numbers and the response of the detector is derived by averaging over large samples of particles. The use of spark-chamber experiments in the field of gamma-ray astronomy has led to the development of Monte Carlo

programs to simulate the cascade processes in these experiments. Such a program, developed in the Max Planck Institut fuer Extraterrestrische Physik, Garching-bei-München, has been recently extended for application to the study of the experiment which will form the payload of the ESRO satellite COS-B. Computations are being carried out in the European Space Research and Technology Centre and the results are presented in comparison with measurements made on a gamma-ray beam from the 500-MeV synchrotron of Bonn University. The extension of the calculations to other experiment configurations and to energies beyond the range of the accelerator is discussed. (auth)

20570 RESOLVING THE MYSTERY OF THE QUASARS. Morrison, P. (Massachusetts Inst. of Tech., Cambridge). Phys. Today; 26: No. 3, 23-29(Mar 1973).

The uniqueness of quasars is discussed and their properties are given. Various theories are considered and it is conjectured that they are highly condensed, rotating centers of extremely distant galaxies. (WDM)

20571 CIRCULAR POLARIZATION OF THE RADIATION FROM COSMIC OBJECTS. Sazonov, V. N. (Lebedev Inst. of Physics, Moscow). Usp. Fiz. Nauk; 108: No. 3, 583-594(Nov 1972). (In Russian).

A short review is presented of recent theoretical and experimental work on circular polarization, particularly as it originates from various cosmic bodies, such as from solar flares, or the radiation belts of Jupiter. Quasars, white dwarfs, planets, and pulsars are given separate treatment as potential sources of circularly polarized radiation. Correlations are advanced between such radiation and the spectral indices of quasars, the relative amount of linear polarization, given wavelengths and other factors. 68 references. (KSW)

20572 TOPICS IN SPINNING BODIES IN GENERAL RELATIVITY. Wilkins, D. C. Stanford, CA; Stanford Univ. (1972). 123p. University Microfilms Order No. 73-4626.

Thesis (Ph. D.).

The dynamics of a spinning particle are treated. The mathematically exact theory, due primarily to Papapetrou, is reviewed. Following Schiff, a nongravitational constraining force is allowed for and it is pointed out that because of the freedom of choice of the local comoving frames, the motion of the spin vector relative to them is quite arbitrary, and therefore without meaning unless the orientations of the local frames are somehow specified. A study was made of the bound orbits of a (nonspinning) particle in the gravitational field of a collapsed rotating body without charge, i.e., a Kerr black hole. The main features of black hole physics are reviewed. The two-body problem was studied by means of two exact solutions (due to Israel–Wilson and Perjés) of the Einstein–Maxwell equations. One system examined consists of two charged black holes; the other consists of two equal charged particles with equal but opposite angular momenta. Both systems are in equilibrium. The hope of seeing black hole formation prompts one to bring together the particles of either system by reducing the parameter of separation. The two black holes coalesce to a new black hole, but the corresponding physical process would take an infinite time as seen by a distant observer in the asymptotically flat background. The two spinning particles do not coalesce to a black hole; rather, the result is an axially symmetric static solution without horizons, and which depends on the initial angular momenta. Two arguments, one concerning the Israel–Wilson–Perjés solutions and one concerning black holes, both point to the existence of a gravitational spin–spin force. Returning to the Papapetrou equations, the spin-force on a test particle in the weak-field, slow-motion approximation, is found. This force is somewhat different from the analogous force on a magnetic dipole in classical electromagnetism. (TSS) (Diss. Abstr. Int., B)

20573 PULSING X-RAY SOURCES. Thomsen, B. (Ole Roemer Observatoriet, Aarhus, Denmark). Astron. Tidsskr.; 5: No. 3, 129-131(1972). (In Danish).

The present state of knowledge of the two pulsating X-ray sources Cyg X-1 and Cen X-3 is reviewed. The variations in intensity and the periods of the pulses characteristic for the two sources are stated and each is identified with a known star, a BOIb star and LR Cen, respectively. The pulsations are explained by both systems being binary stars, the pulses being due to an anti-eclipse effect in Cyg X-1, and to an eclipse effect in Cen X-3. (NO)

20574 DIFFUSE COSMIC GAMMA RAYS. Present Status of Theory and Observations. Stecker, F. W. (Goddard Space Flight Center, Greenbelt, MD). Nature (London) Phys. Sci.; 241: No. 108, 74-77(22 Jan 1973).

Positive diffuse gamma-ray flux measurements now exist for energies up to the 100 MeV range. The totality of the observations in the 10^{-3} to 100 MeV range follows an E^{-2} trend in the differential isotopic photon spectrum but significant features appear. Possible theoretical interpretations of these features are discussed. New results on the diffuse flux from the Galaxy substantiate the pion-decay origin hypothesis for gamma radiation above 100 MeV. (auth)

20575 LINEAR POLARIZATION AND SPECTRUM OF PSR 0833-45 AND THE EFFECTS OF SCATTERING. Komesaroff, M. M. (Commonwealth Scientific and Industrial Research Organization, Epping, Australia); Hamilton, P. A.; Ables, J. G. Aust. J. Phys.; 25: No. 6, 759-777(Dec 1972).

Linear polarization characteristics as well as pulse shape have been measured at Parkes for the average of many pulses from PSR 0833-45 at several frequencies between 300 and 1410 MHz. These confirm a previous conclusion, which was based on pulse shape measurements alone, that the change of pulse character with decreasing frequency can be explained in terms of interstellar scattering. The inferred effect of the scattering medium is explained on the assumption that it comprises many layers of weak uncorrelated density inhomogeneities. Also, some evidence is found for a weak "precursor" pulse, and the possible implications are discussed. (auth)

20576 RCW 117 AND DR 15 OBSERVED IN THE FAR INFRARED. Emerson, J. P.; Jennings, R. E.; Moorwood, A. F. M. (University Coll., London). Nature (London) Phys. Sci.; 241: No. 110, 108-109(5 Feb 1973).

The discovery of two new far infrared objects associated with the H II regions RCW 117 and DR 15 is reported, using the London University College 40 cm stabilized telescope and liquid helium-cooled photometer, balloon flown. The infrared results, together with relevant radio continuum data, are shown tabulated. Agreement between the infrared and radio positions was sufficiently close to assume that the objects are related. RCW 117 is an optical nebula, and the magnitude of the far infrared flux supports the view that it should be classed as a compact H II region. DR 15 shows a radio continuum spectrum and H109α line emission characteristic of thermal H II regions, but there is no evidence that it is compact. A test was made of the theory that far infrared radiation from H II regions can be explained in terms of the degradation of uv photons by dust grains. It was clear that the Ly_0 energy alone is not sufficient to account for the observed infrared fluxes. In the case of compact H II regions optical observations imply that the regions are ionized through a dust cloud around the exciting star or stars. From the size determined for DR 15 it seems probable that at least the far infrared flux for this object is produced throughout the region. (UK)

20577 DETERMINATION OF THE POSITION OF GX2 + 5 WITH COPERNICUS. Hawkins, F. J.; Mason, K. O.; Sanford, P. W. (University Coll., London). Nature (London) Phys. Sci.; 241: No. 110, 109-111(5 Feb 1973).

It is stated that GX2 + 5 was observed on two occasions by the London University College X-ray experiment on board Copernicus. Three of the x-ray detectors were used for the observations—the collimated proportional counter, sensitive in the range 1 to 3 Å, and the two grazing incidence telescopes sensitive in the ranges 3 to 9 and 6 to 18 Å. Full details are given of the technique adopted. It was concluded that the source is located within an error circle of 2 arc min diameter centered on the coordinates RA 17 h 20 min 0.0 s, Dec. −24° 42′ 19″. GX 2 + 5 lies in the direction of the galactic center and reddening caused by interstellar material is very marked. There is no obvious candidate star within the error circle, although a more detailed investigation of the area might reveal one; but a low energy attenuation of the x-ray source with respect to Sco X-1 was observed, and if this is interpreted as due to interstellar material it would imply that the visual object is also heavily obscured. (UK)

20578 APPLICATION OF STATISTICS TO RESULTS IN GAMMA RAY ASTRONOMY. O'Mongain, E. (Smithsonian Astrophysical Observatory, Cambridge, MA). Nature (London); 241: No. 5389, 376-379(9 Feb 1973).

Some of the published results in gamma-ray astronomy are examined, and it is concluded that not all the sources which have been mentioned can be confidently considered to be present. (auth)

20579 IONIZATION POTENTIAL-REDSHIFT CORRELATIONS IN ABSORPTION LINE QSOs. Evans, A. (Univ. of Keele, Eng.). Nature (London) Phys. Sci.; 241: No. 105, 5-7(1 Jan 1973).

Attention has been drawn to an apparent correlation between ionization potential and redshift in the absorption line spectrum of the

QSO 3C 191, and the present author discusses whether any such correlation exists in the absorption spectra of any other QSO. A plot of the difference between the mean emission line redshift of the QSO and the absorption line redshift of any ion against the IP of an atom or ion having one electron more than the absorbing ion is shown. It was essential that values of observed wavelength be accurately determined if the presence of any correlation was to be established. The QSOs considered and absorption redshifts are tabulated, and if a correlation is to be reliably established for any absorption system the number of different ions in the system should be at least four. From the data it is concluded that correlations similar to that in 3C 191 do not exist in the redshift systems of other QSOs. (UK)

Solar Phenomena

Refer also to abstract 20958.

20580 (AD-749869) OBJECTIVE BASELINE FOR FLARE PREDICTION. Podsiadlo, R. T. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass). 14 Jul 1972. 13p. (AFCRL-72-414; AFCRL-ERP-405). NTIS.

The relationship between various measurable solar parameters and solar-flare occurrence is examined utilizing a comprehensive solar-geophysical data base containing a variety of objectively-correlated solar measurements. The sample covers the period from January 1955 through February 1968 and includes such parameters as solar flares, sunspots, magnetic fields of sunspots, calcium plages, and 9.1 cm radio brightness temperatures. A statistical analysis was performed to determine the parameters most useful for the prediction of solar flares 24 hours in advance. Persistence was identified as the single most important flare predictor, with sunspot magnetic classification, 9.1 cm radio brightness temperature, plage brightness, and sunspot area also selected as useful predictors. Objective flare probability prediction equations were developed that incorporate all useful predictors simultaneously. (auth)

20581 EFFECTS OF EROSION AND FRAGMENTATION ON THE MASS DISTRIBUTION OF COLLIDING PARTICLES. Bandermann, L. W. (Univ. of Hawaii, Honolulu). Mon. Notic. Roy. Astron. Soc.: 160: No. 3, 321-338(1972).

Effects of erosion and fragmentation on the distribution of the masses of an ensemble of colliding particles are investigated. An equation for the instantaneous rate of change in the number of particles per unit mass range is formulated and solved numerically. Results for a variety of physical conditions are presented and compared with results obtained by other authors. (auth)

20582 THEORY OF DISSIPATIVE GASES APPLIED TO PLANET FORMATION. Henning, J. J. (Atomic Energy Board, Pretoria). pp N.1-11 of Fifth Annual Seminar on Theoretical Physics. Pretoria; Atomic Energy Board (1970).

From 5th annual seminar on theoretical physics; Pretoria, South Africa (13 Jul 1970). See CONF-700728.

The nonrelativistic equations for the conservation of linear and total angular momentum for spherical particles exerting frictional (rubbing) and restitutive forces on each other are obtained. The kinetic theory for a gas of such particles is considered and the Boltzmann equation as well as the generalized balance equations are given. It is found that a gas consisting of these particles is cooled and the cooling rate is calculated. The theory is applied to interstellar systems where the effect of gravitational contraction of the system is neglected. (auth)

20583 PHOTOSPHERIC FACULA CONTRAST IN BLUE LIGHT. Tskhovrebadze, A. S. Byull. Abastumanskaya Astrofiz. Observ., Akad. Nauk Gruz. SSR; No. 40, 97-100(1971). (In Russian).

A total of 112 solar facula filaments, selected from 10 high quality blue-light solar limb photographs, were studied photometrically to determine the spatial variation in their contrast levels with respect to an unperturbed chromosphere. A distinct increase in the contrast level is established along the faculae from the center of the Sun toward the solar limb. (IAA)

20584 OBSERVATION OF A FLARE ON THE SOLAR LIMB ON NOVEMBER 4, 1968. Khetsuriani, Ts. S.; Tetruashvili, E. I. Byull., Abastumanskaya Astrofiz. Observ., Akad. Nauk Gruz. SSR; No. 40, 93-96(1971). (In Russian).

Photographs of a flare taken through the clouds on the horizontal chromospheric telescope of the Abastumani Observatory are given. The observation of an extremely intense prominence in the aftermath of the flare is noted. The flare is characterized as a rare phenomenon because it produced a green coronal luminescence more intensive than that of the scattered light of the cloudy sky. (IAA)

20585 SOLAR CORONA DURING THE TOTAL SOLAR ECLIPSE OF SEPTEMBER 22, 1968. Khetsuriani, Ts. S.; Tetruashvili, R. I.; Kiladze, G. N.; Salukvadze, G. N.; Khatisov, A. Sh. Byull., Abastumanskaya Astrofiz. Observ., Akad. Nauk Gruz. SSR; No. 40, 55-92(1971). (In Russian).

A 13-cm meniscus telescope with a 1-m focal length and a red filter was used for telemetry and a 10-cm telescope with a 50-cm focal length was used for polarization measurements in a photographic study at wavelengths from 6000 to 7000 A of the solar corona during this eclipse. An automatic micrometric recorder was used for measurements on the photographs, and the photometric data were referred to absolute units. The decrease of the average intensity of the premaximum-type corona with the distance from the Sun was consistent with observations of van de Hulst during a solar activity maximum. Large area-to-area polarization level variations were observed in the corona. (IAA)

20586 MEZHPLANETNAYA SREDA I FIZIKA MAGNITOSFERY. (Interplanetary Medium and the Physics of the Magnetosphere). Skuridin, G. A. (ed.). Moscow; Izdatel'stvo Nauka (1972). 212p.

This collection of 16 papers by different authors is concerned with various aspects of Sun–Earth physics: the magnetosphere, geomagnetic waves and directed geomagnetic fields, energy dissipation, and methods of measurement. Studies have also been directed toward high-frequency turbulence in the cosmic plasma, the structure of the convective shell of the Sun, cosmic radiation in the vicinity of the Moon, and low-energy protons of solar origin. The limits of the magnetosphere, and the subject of thermal instability and energy relationships in convection shells of slowly rotating stars are examined. (KSW)

20587 INTERACTION BETWEEN THE SOLAR WIND AND INTERSTELLAR NEUTRAL PARTICLES. Winter, E. M. Los Angeles; Univ. of California (1972). 180p. University Microfilms Order No. 73-1742.

Thesis (Ph. D.).

The interaction between the solar wind and the interstellar neutral medium is studied through an extension of continuum techniques. These interstellar neutral particles, the presence of which in interplanetary space has been determined by measurement of solar Lyman alpha back-scattered radiation, can be considered as a distributed source of mass, momentum, and energy sources in the continuum equations. A multi-fluid approach is utilized to arrive at a generalized Ohm's law relating the current to the electric field. With these sources, the solar wind is found to behave in a manner analogous to an ion–electron–neutral plasma, coupled by collisions. In addition, the thermal energy equation is found to differ from the case without sources in the flow. As a result, the assumptions of infinite conductivity and a polytropic relation between pressure and density can not be employed. Models of the density of these neutral particles are developed taking into account the effects of solar gravity, light pressure, varying composition, and temperature. These models are then used along with the interaction theory to predict interaction effects in the outer solar system. The effect of the interstellar particles upon the interstellar magnetic field is developed from a study of the behavior of single particles. It is found that the ionization of interstellar neutral particles in the presence of the electromagnetic field can result in transfer of momentum from the field to the newly ionized particles. One effect of the loss of momentum by the field is an unwinding of the spiralled magnetic field of the solar wind. The magnitude of this effect is evaluated for the models of neutral density mentioned above. For the case of an interstellar number density of 0.1 cm^{-3} and a velocity of 20 km sec^{-1} relative to the Sun, the spiral angle reaches a maximum value of 62° at approximately 3 AU and then decreases with increasing distance from the Sun to less than 45° (the value at 1 AU at the orbit of Jupiter. The second effect is the increased ion temperature over that predicted by an adiabatic expansion model without sources in the flow. For the case mentioned above, the ion temperature is predicted to be approximately an order of magnitude greater than without such sources. The conditions for a shockfree transition in the flow are reviewed through a critical point analysis. The occurrence of such a transition from supersonic to subsonic flow is unlikely within the heliosphere. The unwinding of the spiralled magnetic field is discussed with relation to present evidence for an effective radius of modulation of galactic cosmic rays. Since the path length of a cosmic ray diffusing in from the heliopause is less for partially unwound spiral than for the Parker spiral, the model appears to be consistent with the evidence that the region of modulation is limited to 3 to 5 AU. (Diss. Abstr. Int., B)

20588 HEOS 2 AND HELIOS MICROMETEOROID EXPERIMENTS. Dietzel, H.; Eichhorn, G.; Fechtig, H.; Gruen, E.;

Hoffman, H. J.; Kissel, J. (Max-Planck-Institut fuer Kernphysik, Heidelberg). J. Phys., E (London); 6: No. 3, 209-217(Mar 1973).

Two micrometeoroid experiments based on the plasma emission caused by impacting hypervelocity dust particles are described. Since January 31, 1972 the first has been flying on the HEOS 2 satellite orbiting the Earth in a highly eccentric polar orbit. The second experiment will be flown in 1974 on the HELIOS probe which will orbit the Sun with a perihelion of about 0.3 AU. The aim of these experiments is to measure the mass and speed of micrometeoroids and to determine their approximate orbital elements. The HELIOS version will in addition analyse the constituents of the plasma cloud, thus delivering information about the chemical composition of the micrometeoroids. The ions and electrons of the plasma cloud released during the impact are separated by an electric field and registered by charge sensitive amplifiers, thus delivering two pulses. Pulse height and rise time are correlated with the mass and speed of the projectile. In the HELIOS version the ions are in addition accelerated by an electric field before entering a time-of-flight tube. According to their charge-to-mass ratio the mass spectrum of the ions is recorded by a particle multiplier at the end of the tube. (auth)

20589 MIXING IN STELLAR MODELS. Ulrich, R. K.; Rood, R. T. (California Inst. of Tech., Pasadena). Nature (London) Phys. Sci.; 241: No. 110, 111-112(5 Feb 1973).

It has been proposed that the absence of a detectable neutrino flux from the Sun, and also geological ice ages, are consequences of occasional mixing in the solar core (Dilke and Gough, Nature 240: 262 (1972)). In the present communication stellar model calculations are presented that give rise to serious doubts whether this can solve the solar neutrino problem. The results also have important implications for semi-convection theory. (UK)

20590 SOLAR NEUTRINO PROBLEM. No Low Energy $^3He + ^3He$ Resonance. Parker, P. D.; Pisano, D. J.; Cobern, M. E.; Marks, G. H. (Yale Univ., New Haven). Nature (London) Phys. Sci., 241: No. 110, 106-108(5 Feb 1973).

From a study of the $^6Li(^3He,t)^6Be$ reaction, experimental evidence is presented against the existence of the $^3He + ^3He$ resonance corresponding to a level at 11.5 MeV in ^6Be which has been suggested as an ad hoc solution to the solar neutrino problem. The $^6Li(^3He,t)$ ^6Be data establish a limit on the spectroscopic factor $S(^6Be^* \rightarrow ^3He + ^3He)$ of less than 6×10^{-3} for any state in this region of ^6Be. (auth)

20591 NORMAL INCIDENCE RADIATION TRENDS ON MAUNA LOA, HAWAII. Pueschel, R. F.; Machta, L.; Cotton, G. F.; Flowers, E. C.; Peterson, J. T. (Maunda Loa Observatory, HI). Nature (London); 240: No. 5383, 545-547(29 Dec 1972).

Monitoring of solar radiation at the Mauna Loa Observatory, initiated in 1958, is discussed; the geographic and topographic location of the Observatory greatly enhances the quality of measurements, and the site possesses many other advantages. Eight pyroheliometers have been used in the programme, but a continuing problem has been uncertainties in calibration and stability of the instruments. No systematic trend in transmission factor data was detected in solar insolation over the period 1958 onwards, but short term effects of volcanic activities were discernible; a removal time of volcanic aerosols in the stratosphere of up to 7 years was indicated. Amongst conclusions reached was that the transmission of solar radiation received by the Earth apparently undergoes annual cycles such that atmospheric transmission is lower during the summer months, and that the amplitude of the seasonal variations is constant, except for effects due to volcanic activities. The matter of seasonal turbidity variations is also discussed; whatever their cause it is proposed that turbidity fluctuations take place in the troposphere. The question of how man-made pollution will affect the annual transmission cycle is also briefly discussed. (UK)

20592 SOLAR ACTIVITY AND X RADIATION. Ohki, Kenichiro (Tokyo Univ.). Kagaku (Tokyo); 42: No. 8, 414-421 (Aug 1972). (In Japanese).

Observation of solar activity by various methods is reviewed. In 1960, an artificial satellite, SOLRAD-I, made it possible to observe x-rays and ultraviolet, and to study solar flares. The satellite SOLRAD-I gave various information, such that intensity of the x-rays was over 0.6×10^{-3} erg $\cdot$ cm^{-2} $\cdot$ sec^{-1} only when Hα flares, active prominences, or limb surges were seen. Orbital Solar Observatory (OSO) series observed spectra of soft x-ray flares, and found Fe XXV and Fe XXVI. Temperatures were estimated to be between 10,000,000°K and 50,000,000°K. Observation of microwaves showed weak intensity except in impulsive or Type IV bursts. Most of the bursts seemed to be thermal radiation. The intensity of microwaves obtained from the temperature and emission measure in the region emitting soft x rays was in agreement with the result of real observation of the GRF burst. This agreement suggests that the soft x rays and the microwaves are emitted from the common region of whole coronal condensation. Observation of hard x rays with a satellite OGO-V was performed by Kane. The observation showed that the hard x rays of nonthermal spike type continuing less than 1 min and thermal x rays continuing more than several minutes were in a band between 10 and 50 keV. Kane and Anderson investigated 13 typical impulsive hard x-ray bursts. Mechanism of acceleration of nonthermal particles and heating of hot regions are discussed. (JA)

20593 RECORD-BREAKING COSMIC RAY STORM STEMMING FROM SOLAR ACTIVITY IN AUGUST 1972. Pomerantz, M. A.; Duggal, S. P. (Bartol Research Foundation, Swarthmore, PA). Nature (London); 241: No. 5388, 331-333(2 Feb 1973).

A description is given of the general features of the greatest cosmic-ray storm ever observed which commenced on August 4th, 1972, and of which sunspot group 331 was the ultimate source. The storm occurred near the minimum of an unspectacular solar cycle and the Forbush decreases reached 27% in about 24 hours. A nucleonic intensity profile of the storm is shown as observed at a typical mid-latitude station; it followed three large solar flares that produced the most severe disturbances during the current solar cycle in the many diverse phenomena included in solar–terrestrial physics. Details of the structure of the storm are given and possible mechanisms discussed. The observations implied that the primary cosmic-ray flux in the vicinity of the Earth was cut almost in half by disturbances in a single localised region on the Sun. (UK)

20594 SOLAR GAMMA RAY LINES OBSERVED DURING THE SOLAR ACTIVITY OF AUGUST 2 TO AUGUST 11, 1972. Chupp, E. L.; Forrest, D. J.; Higbie, P. R.; Suri, A. N.; Tsai, C.; Dunphy, P. P. (Univ. of New Hampshire, Durham). Nature (London); 241: No. 5388, 333-335(2 Feb 1973).

Preliminary observations are reported, obtained from the satellite OSO-7, on the emission of γ-ray lines associated with the solar flares on August 4 and 7, 1972. These are stated to be the first observation of such solar γ rays. The γ-ray monitor consisted of a NaI(Tl) crystal located in the rotating wheel compartment of the satellite. Detailed spectrum analysis showed evidence for solar flare γ-ray line structure centered at several different energies, and especially at ~4.4 and ~6.1 MeV. X-ray data were also obtained, using a four-channel x-ray detector associated with the γ-ray monitor. The most straightforward interpretation of the observations was the near simultaneous production of nonthermal x rays to energies > 2 MeV and γ-ray lines produced by a variety of high-energy reactions associated with the production of solar cosmic rays; these are discussed. Evidence was also obtained for lines at 0.5 and 2.2 MeV. It was concluded that the monitor recorded a solar burst most probably of annihilation radiation and the D formation γ-ray in the flares, and also solar γ-ray lines probably from the excited states of ^{12}C and ^{16}O. A brief summary is given of tentative solar flux values at the Earth for these spectral lines. It is tempting to believe that the observations give direct evidence that solar cosmic rays are accelerated in the explosive phase of the optical flare. (UK)

20595 DETECTION OF RELATIVISTIC SOLAR PARTICLES BEFORE THE H_α MAXIMUM OF A SOLAR FLARE. Mathews, T.; Lanzerotti, L. J. (Univ. of Calgary, Alberta). Nature (London); 241: No. 5388, 335-338(2 Feb 1973).

The first detection of relativistic solar protons before the H_α maximum phase of a solar flare and in near coincidence with the maximum phase of the white-light flare is reported. The observations are stated to have important implications for theories of particle acceleration during flares and for the appropriate particle injection times to be used in the modelling of solar particle events by diffusion theories. Seventeen ground level solar particle events were observed with neutron monitors between February 1956 and September 1971. In the case of all of these that could be associated with a flare on the visible disk relativistic particles were first observed at the Earth with time delays ranging from $\gtrsim$5 min to more than 1 h following flare maximum. The absence of observations of such particles prior to, or at the same time, as the flare maximum has been interpreted as being due to problems of coronal and interplanetary propagation. (UK)

Galaxies

Refer also to abstract 20556.

20596 (AD-748983) APERTURE SYNTHESIS STUDY OF NEUTRAL HYDROGEN IN NGC 2403 AND NGC 4236. I. Observations. II. Discussion. Shostak, G. S.; Rogstad, D. H. (Owens Valley

Radio Observatory, Pasadena, Calif.). 1972. Contract N00014-67-A-0094-0019. 60p. NTIS.

Observational results of an aperture synthesis study of neutral hydrogen in the nearby galaxies NGC 2403 and NGC 4236 are presented. Maps of the integral of the line profile at each position on the galaxies are given, as well as maps showing lines of constant radial velocity determined from the peaks of the profiles. Spatial resolution is 2' of arc; velocity resolutions is 21 km/s. In addition, line profiles for the galaxies as a whole and maps of the 1420 MHz continuum radiation from each object are displayed. (auth) (NTIS)

20597 STUDY OF THE PLANE GALACTIC ORBITS OF STARS BY USING DIFFERENT EXPRESSIONS FOR THE GRAVITATIONAL POTENTIAL. Malasidze, G. A. Byull., Abastumanskaya Astrofiz. Observ., Akad. Nauk Gruz. SSR; No. 40, 123-170(1971). (In Russian).

Stellar orbits in the symmetry plane of the Galaxy were analyzed by using a previously proposed general expression (1969) for the gravitational potential which allows an elliptic-integral solution for plane orbits in a stationary spherical stellar system. Available observational data were used to select parameters for the expression, and the latter was applied to analyze the galactic orbits of 5 stars contained in Eggen's fast star catalog (1964). The dependence of the anomalistic periods and eccentricities of these stars on the gravitational potential were determined. (IAA)

20598 STRUCTURE OF THE STELLAR FIELD IN THE DIRECTION OF NGC 2129 CLUSTER. Kalandadze, N. B.; Kolesnik, L. N L. N.; Kuznetsov, V. I. Byull., Abastumanskaya Astrofiz. Observ., Akad. Nauk Gruz. SSR; No. 40, 39-54(1971). (In Russian)

Characteristics of a 1-sq deg Milky Way area stretching toward the galactic anticenter and centered at NGC 2129 were analyzed. Interstellar radiation absorption and the distribution of stars in this area are discussed, showing the presence of three cosmic dust clouds along the line of sight over the distance of 1500 pc toward the anticenter, with almost absorption-clear interspaces. Contrary to observations of McCusky (1966), a decrease in the spatial density of A8-F3 stars was not observed at distances between 400 and 900 pc in the direction of the anticenter. (IAA)

20599 MODEL FOR PEAKING OF GALACTIC GRAVITATIONAL RADIATION. Campbell, G. A.; Matzner, R. A. (Univ. of Texas, Austin). J. Math. Phys. (N.Y.); 14: No. 1, 1-6(Jan 1973).

Geometrical optics is used to calculate the radiation pattern from a source in orbit in a strong gravitational field. No specific mechanism is postulated for the radiation itself, and only the field's effect on the radiation enters. (The model proposes a "black hole" at the galactic center.) Besides the Doppler peaking expected in these orbits, we find that the gravitational lens effect can enhance the radiation (regardless of how the radiation is produced). If the radiation arises from individual short events, the gravitational lensing leads to a scatter in the observed intensity. Formulas are presented for the probability a certain pulse will exceed the average by a given factor for a detector of finite sensitivity. Enhancement as found here, if present in the galaxy, would lower the overall galactic mass loss implied by Weber's gravitational radiation measurements. (auth)

20600 MOLECULES AND EVOLUTION IN THE GALAXY. Buhl, D. (National Radio Astronomy Observatory, Green Bank, WV). Sky Telesc.; 45: No. 3, 156-158(Mar 1973).

Molecules identified in interstellar clouds and the galactic center are listed. Conditions in prestellar condensations conducive to the formation of heavy molecules are discussed. (WDM)

20601 ENERGY SOURCE FOR DRIVING THE INTERSTELLAR GAS. Basu, B. (Jadavpur Univ., Calcutta). Indian J. Phys.; 46: No. 8, 379-386(Aug 1972).

On the basis of the recent observations of high-speed mass ejection from the blue giants and supergiants, a quantitative estimate of the available kinetic energy by the process was made. It was found that the amount of kinetic energy thus produced may be comparable to that available from the ultraviolet radiation of the early-type stars. But neither of these sources appears sufficient to replenish the kinetic energy dissipated by the cloud collision process. It is suggested, however, on theoretical grounds that the actual rate of mass loss from blue giants and supergiants may be much higher than computed so far. The resulting higher amount of kinetic energy poured into the interstellar space may be the most important source for the replenishment of the kinetic energy lost by the interstellar cloud collisions. (auth)

20602 INTERSTELLAR MOLECULES. Turner, B. E. Sci. Amer.; 228: No. 3, 51-62; 67-69(Mar 1973).

Topics discussed in this review include emission from hydroxyl, more complex molecules, location of molecules, dark clouds and protostars, interstellar masers, molecules as interstellar probes, chemical composition of clouds, molecules and background radiation, isotope abundances, molecular life cycles, and further questions. (WDM)

20603 INTERSTELLAR MOLECULES. Solomon, P. M. (Univ. of Minnesota, Minneapolis). Phys. Today; 26: No. 3, 32-40(Mar 1973).

The interpretation of data from massive molecular clouds is emphasized in terms of the physical and chemical conditions in these regions and some of the results of the past two years are summarized. The discussion is based primarily on mm observations with the NRAO 36-ft antenna. The discussion includes sources of molecular line radiation, physical conditions in molecular clouds, galactic structure, isotopic abundances, and interstellar chemistry. (WDM)

20604 GAMMA RAY LINE FROM THE GALACTIC CENTRE. Guthrie, P.; Tademaru, E. (Univ. of Massachusetts, Amherst). Nature (London) Phys. Sci.; 241: No. 108, 77-79(22 Jan 1973).

Reference is made to Johnson and others (Astrophys. J. Lett. 172: L1(1972)) who published a spectrum of low-energy γ rays from the direction of the galactic center and found a spectral feature at 473 ± 30 keV with photon flux $(1.8 \pm 0.5) \times 10^{-3}$ cm^2/S. Possible physical explanations of this feature are discussed, assuming it is a real line. A γ-ray line in this energy range may be due either to nuclear de-excitation or to the annihilation of electron–positron pairs, in the latter case gravitationally redshifted by ~7% in energy. It is argued that the observed γ-line feature may be due to pair annihilations; this hypothesis seems preferable to nuclear de-excitation, since only a mechanism to produce positrons is required, rather than a specific radioactive nucleus. It must then be explained, however, why the feature appears at 473 keV, involving a redshift of some 7% in energy from the expected 511 keV. Doppler shifts seem to be an unlikely explanation and this leads to the consideration of gravitational redshifts. A neutron star would appear to gravitationally redshift any line produced at its surface by 1 to 10%; annihilation at the surface then might easily account for the observed line, and this hypothesis is pursued. The presence of pairs must then be accounted for; in this connection if the star is rapidly rotating and has a very large magnetic field, pair production may be very efficient. The effect of accretion is also discussed. (UK)

20605 ANIONIC SPECIES OF Fe IN INTERSTELLAR DUST. Manning, P. G. (Dept. of the Environment, Ottawa). Nature (London); 240: No. 5383, 547(29 Dec 1972).

It is stated that interstellar dust may contain the anionic species FeO_4^{2-} and FeO_2^-, which are thermally degradable to a likely interstellar material $\alpha-Fe_2O_3$. The spectrum of FeO_4^{2-} shows two overlapping bands centered at 17,800 and 19,700 cm^{-1}, in striking coincidence with the 17,500 and 17,700 cm^{-1} supernova bands, and differential thermal analysis has shown that $\alpha-Fe_2O_3$ is formed at ~800 K, with $KFeO_2$ as an intermediate in the degradation of FeO_4^{2-} to $\alpha-Fe_2O_3$. It seems that the grains responsible for supernova absorption, in contrast to the diffuse interstellar grains, have not been heated sufficiently in a reducing atmosphere to convert FeO_4^{2-} to $\alpha-Fe_2O_3$. Ferrates could condense during the expansion phase following supernova explosions, or alternatively could form in the atmospheres of oxygen-rich stars and then be ejected into space. (UK)

20606 LIST OF GALAXIES WITH PECULIAR NUCLEI. Sersic, J. L. (Observatorio Astronomico, Cordoba, Argentina). Publ. Astron. Soc. Pac.; 85: No. 503, 103(Feb 1973).

A list of galaxies with peculiar nuclei is given which were found in the Hubble Plate Collection at the Hale Observatories in 1966. (WDM)

20607 LOW-DISPERSION SPECTRA OF GALAXIES. III. Abell No. 194. Davis Philip, A. G. (State Univ. of New York, Albany); Sulentic, J. W. Publ. Astron. Soc. Pac.; 85: No. 503, 104-108(Feb 1973).

Low-dispersion spectra (≃ 10,000 Å mm^{-1}) were obtained of the brighter members of the cluster of galaxies, Abell 194. The reddest and bluest galaxies in the cluster were identified and a color–magnitude diagram is presented. (auth)

20608 DYNAMICS OF DENSE STELLAR SYSTEMS. Saslaw, W. C. (Univ. of Virginia, Charlottesville). Publ. Astron. Soc. Pac.; 85: No. 503, 5-23(Feb 1973).

This is a review of the main physical processes which occur in dense stellar systems: gravitational relaxation, evaporation of stars, antiequipartition, growth of dense cores, stellar co-

alescence, stellar disruption, star–gas interactions, and star formation. These processes are combined to sketch theories of the formation, intermediate evolution, and ultimate fate of galactic nuclei. (auth)

Cosmology

20609 HYPOTHESIS RELATING THE STRUCTURE AND ENTROPY OF THE UNIVERSE. Zel'dovich, Ya. B. (Inst. of Applied Mathematics, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 1, 58-66(Jan 1973). (In Russian).

An hypothesis is proposed in which it is assumed that near the cosmological singularity the Universe was initially filled with cold baryons. Averaged evolution is described by uniform isotropic expansion in accordance with the Friedmann solution and the equation of state of cold baryons. Scale-independent metric perturbations of the order of 10^{-4} are superimposed. The short-wave part of the perturbations explains the entropy of the big-bang Universe whereas the longwave part describes formation of galaxy clusters and the approximate uniformity of the Universe as a whole. (auth)

20610 CREATION OF THE UNIVERSE. Krogdahl, W. S. (Univ. of Kentucky, Lexington). Sky Telesc.; 45: No. 3, 140-143 (Mar 1973).

The questions of the origin, age, bounds, and history of the Universe are discussed. Milne's model of kinematical relativity is considered. (WDM)

20611 COMPUTATION OF THE EINSTEIN TENSOR WITH FORMAC. Payne, A. D. (Univ. of Toronto). Comput. Phys. Commun.; 4: No. 1, 100-106(Oct 1972).

The Einstein tensor can be derived from the covariant metric tensor. However, if the metric components are complicated functions of the coordinates or the metric is not orthogonal then the derivation by hand can be quite tedious. A FORMAC program is described which provides automatic computation of the Einstein tensor. (auth)

20612 NONSYMMETRIC, GRAVITATIONAL COLLAPSE OF AN INFINITE, DUST-FILLED CYLINDER. Miketinac, M. J.; Barton, R. J. (Univ. of Saskatchewan, Regina). Int. J. Theor. Phys.; 6: No. 6, 437-442(Dec 1972).

Nonsymmetric terms or angle-dependent terms in the power series expansion of Einstein's equations are considered. It is shown, first, that they do not influence the time evolution of the symmetric terms and, second, that they do not remain bounded as the cylinder collapses. However, the major contribution to the density arising from the symmetric terms makes the nonsymmetric contribution progressively more insignificant as the collapse proceeds. (auth)

20613 GRAVITATIONAL WAVES: A PROGRESS REPORT. Logan, J. L. (Rockefeller Univ., New York). Phys. Today; 26: No. 3, 44-50; 52(Mar 1973).

Current experiments in the detection of gravitational radiation are discussed along with some of those planned for the next few years. (WDM)

20614 STUDY OF GRAVITATIONAL FIELDS IN AN ANISOTROPIC MODEL WITH MATTER AND NEUTRINOS. Shikin, I. S. (Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 63: No. 5, 1529-1537(Nov 1972). (In Russian).

An anisotropic model of the Bianchi Type I is considered within the framework of general relativity under the assumption that the gravitational field sources are matter with an equation of state $p = (\gamma - 1)e$ and collision-free neutrinos. The covariant Dirac equation for 4-component spinors is employed for describing the two fluxes of the 2-component neutrinos. A qualitative analysis of the Einstein equations is presented for the case of axial symmetry and various equations of state. Analytic expressions are obtained for the ultrarelativistic equation of state $e = 3p$. Analytic expressions are also given for $e = p$. The effect of free-neutrino fluxes on the dynamics is discussed. (auth)

20615 NIGHT SKY BACKGROUND MEASUREMENT AT 6 TO 0.3 mm. Williamson, D. D.; Blair, A. G.; Catlin, L. L.; Hiebert, R. D.; Loyd, E. G.; Romero, H. V. (Los Alamos Scientific Lab., NM). Nature (London) Phys. Sci.; 241: No. 108, 79-80(22 Jan 1973).

Photometric measurements of the night sky background were made in three spectral regions on May 17, 1972 using a far infrared radiometer cooled by superfluid helium, launched on a rocket from the Kauai Test Range, Hawaii. A background flux consistent with a 2.7 K blackbody source was obtained, and details of the experiment are given, including data analysis. These experiments are stated to lend substantial support to the big bang cosmology. (UK)

20616 ORIGIN OF DEUTERIUM. Hoyle, F.; Fowler, W. A. (California Inst. of Tech., Pasadena). Nature (London); 241: No. 5389, 384-386(9 Feb 1973).

The origin of deuterium has always been a problem for theories of stellar nucleosynthesis. A general solution is proposed and shown to be applicable under several astrophysical circumstances in the light of new observations of the galactic abundance of deuterium. (auth)

20617 SYNCHROTRON GRAVITATIONAL RADIATION. Doroshkevich, A. G.; Novikov, I. D.; Polnarev, A. G. (Inst. of Applied Mathematics, Moscow). Zh. Eksp. Teor. Fiz.; 63: No. 5, 1538-1547(Nov 1972). (In Russian).

The intensity, spectrum, and angular distribution of gravitational radiation emitted by a dumbbell rotating with a relativistic velocity are calculated. The finite sizes of the masses are important in the case of rotation of masses with a velocity approaching that of light. Conclusions regarding emission of gravitational waves by light wave packets are drawn. (auth)

20618 COMMENT ON "NON-VELOCITY REDSHIFTS AND PHOTON–PHOTON INTERACTIONS." Aldrovandi, R.; Caser, S.; Omnes, R. (Paris Univ., Orsay, France). Nature (London); 241: No. 5388, 340-341(2 Feb 1973).

It has been suggested that some redshifts can be explained by considering a new type of process in which a photon scatters inelastically on the 3K radiation to give four less energetic photons. The mathematics of this process are considered. It is found that such a process does not lead to strong peaking in the forward direction, which is necessary to obtain a point-like image of the source. It is also found that there is no well-defined redshift independent of the frequency of the incident photon, but the frequency response is spread all over the available phase-space, giving grey radiation rather than a shifted line. It is therefore concluded that the process cannot account for any observed redshift. (UK)

20619 PHOTON MASS, QUASAR REDSHIFTS, AND OTHER ABNORMAL REDSHIFTS. Pecker, J. C.; Tait, W.; Vigier, J. P. (College de France, Paris). Nature (London); 241: No. 5388, 338-340(2 Feb 1973).

The application to quasars of a mechanism that is stated to provide a simple explanation of the chief observational paradoxes which have prevented a coherent understanding of the nature and distance of QSO sources is discussed. This new mechanism rests on the possible existence of a non-zero photon mass of $<10^{-48}$ g, and explains not only the QSO redshifts, but several other phenomena. Inelastic photon–photon collisions are introduced which yield a constant fractional energy loss cross section independent of the photon energy, have a very strong forward peak, and do not invalidate quantum electrodynamics, provided suitable form factors are used which drop sharply off the mass shell. This theory might somewhat modify ideas concerning expansion of the Universe. It is thus claimed that, in addition to the cosmological redshift, there exists, particularly strong in quasars, another source of redshift, the photon–photon interaction. The mechanism adds two astrophysical processes to the well known sources of redshifts, both consequences of photon–photon interactions; first a redshift associated with travel of photons from a remote source to the observer, through the interstellar microwave field of 2.7 K; and second a "source" redshift associated with the existence of a photon bath surrounding radiating sources. It is suggested that QSOs are extended structures, with massive cores and a relatively high average temperature, surrounded by a transparent region. The value obtained for z will be 0.8, a sensible average value for QSOs. A continuity of physical characteristics in going from quasars through compact galaxies to companion galaxies is stated to be possible, and also that the "true" distance of QSOs is from 10 to 1000 times smaller than is generally assumed. Finally radio emission by QSOs is due to the long wavelength component of the spectrum emitted by the photon–photon interactions. (UK)

20620 DIFFICULTIES CONCERNING A FINITE PHOTON REST MASS. Woodward, J. F.; Yourgrau, W. (California State Univ., Fullerton). Nature (London); 241: No. 5388, 338(2 Feb 1973).

It has been suggested by Pecker and others (Nature 237: 227 (1972)) that much, if not all, of the cosmological redshift might be attributable to inelastic photon–photon scattering if the photon posesses a finite rest mass, and this suggestion has been applied to electromagnetic propagation anomalies. The present auth[illegible]s

agree in part with this hypothesis, but consider that it cannot be completely correct as stated. To test if the various propagation anomalies are the result of an anomalous photon graviton interaction an investigation was made to ascertain whether transient propagation anomalies are manifested in optical frequency deflection observations; the results seemed to be positive. If inelastic photon–photon scattering occurs, the mechanism must be more complex than that advanced by Pecker. The mechanism of Pecker is defective because it only partially meets the requirements of a "tired light" effect. (UK)

20621 ANTIMATTER. Some Recent Developments. Swetman, T. P. (Cambridgeshire Coll. of Arts and Tech., Eng.). Phys. Educ.; 8: No. 1, 50-52(Jan 1973).

The early history of the study of antimatter, especially by Dirac in the 1930s, is outlined. More recently the realization that a fundamental invariance principle requires that for each ordinary particle that we know of there should exist a corresponding antiparticle, having the same mass and spin as the particle but opposite charge and magnetic moment, has led to a search for evidence of an antiparticle for each newly discovered particle. The discovery of the antideuteron and of the anti-omega particle are especially mentioned. The present search for antimatter on a larger scale is reviewed. This question has been considered by a large number of physicists and, although as yet no definitive evidence has been forthcoming, there has been a great deal of interesting experimentation and speculation. The search for antiprotons and other antinuclei in the primary cosmic radiation is mentioned, the question of whether ball lightning could be caused by antimatter meteorites and the possible existence of antimatter on a cosmological scale as one of the most basic problems in physics are considered. (UK)

Planetary Phenomena

20622 ASTEROID HEATING BY SHORT-LIVED RADIOISOTOPES. Levin, B. Yu.; Maeva, S. V. (Inst. of Physics of of the Earth, Moscow). Meteoritika; No. 31, 18-23(1972). (In Russian).

Calculations of the possible thermal history of asteroids suggested that if the initial content of ^{26}Al were sufficiently high, the heat released could cause a body of radius ≥ 20 km to attain a temperature requisite for the metamorphorsis which has been observed in meteorites. In a similar fashion, for a radius of 5 to 10 km, a temperature of some hundreds of degrees would be reached. (tr-auth)

20623 MARS FROM MARINER 9. Murray, B. C. Sci. Amer.; 228: No. 1, 49-63; 66-9(Jan 1973).

The results from the Mariner 9 mission to Mars are discussed in terms of surface features, climate, atmosphere, and internal heating. (WDM)

20624 COMPUTER SIMULATION OF Pb AND Sr ISOTOPE EVOLUTION OF THE EARTH'S CRUST AND UPPER MANTLE. Armstrong, R. L.; Hein, S. M. (Yale Univ., New Haven). Geochim. Cosmochim. Acta; 37: No. 1, 1-18(Jan 1973).

Isotope evolution in a differentiated (crust and upper mantle) and chemically heterogeneous Earth has been computed for a model with isotopic exchange between crust and mantle at an exponentially decreasing rate. To simulate the effects of subduction, cells of crust and mantle are selected at random, their contents mixed and then redistributed into the cells from which they came—to give new chemically heterogeneous but momentarily isotopically homogeneous systems. Daughter isotopes in each cell grow according to equations appropriate for closed chemical systems. Rock age distributions and isotopic data created by the computer calculation mimic nature. Pb isotope data changes through geologic time are illustrated to demonstrate that two-stage interpretations applied to Pb data for rocks with complex histories may be misleading. The intercept of the Pb ore growth curve and regressions fit to Pb data gives minimum values only for the duration of heterogeneous U/Pb systems, not the time when heterogeneous distribtuion first occurred. An intercept derived time of about 3 b.y., in the Pb system is shown to be quantitatively compatible with an average Rb/Sr age of crustal rocks of 1.5 b.y. and with a constant degree of chemical heterogeneity for all of Earth history. (auth)

20625 FINE STRUCTURE OF THE JUPITER RADIO BURSTS. Ellis, G. R. A. (Tasmania Univ., Sandy Bay, Australia). Nature (London); 241: No. 5389, 387-389(9 Feb 1973).

It is stated that short pulses with a time scale of milliseconds have been observed for a long time past in the radio emissions of Jupiter at ~20 MHz. Little is known about these "S" bursts, although it has been established that their occurrence depends strongly on the orbital position of the satellite Io. In the observations reported (May to September 1972) a time resolution of 0.5 ms combined with a frequency resolution of 10 kHz was attained at radio frequencies using the technique of time-expansion spectrographic analysis (Dowden, Nature 207: 493 (1965)). Signals received in the frequency range 15 to 18 MHz were reduced in frequency to 0 to 3 MHz and recorded on a helical scan video recorder and the frequency-time information was analysed. Examples of the different types of bursts observed are shown and described. The overall duration for most bursts was ~60 ms, but some sub-millisecond bursts were also observed. On a time scale of 100 ms a class of bursts was observed with no particular frequency–time slope of duration 0.1 to 1.0 s. It has been suggested that radio bursts with general frequency–time characteristics may result from the passage of electron streams of about 10 keV energy through the spatially varying magnetosphere of Jupiter. Changes in the frequency–time slope are those that would be expected if the radiated wave frequency is near the local cyclotron frequency of electrons in the magnetosphere and if the rate of change of frequency with time arises from the longitudinal speed of the electrons and the spatial variation of the magnetic field. The effect of the orbital motion of Io relative to the Jupiter magnetosphere is discussed. (UK)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstracts 20675 and 20676.

20626 (AD-748176) NONLINEAR EVOLUTION OF WHISTLER INSTABILITIES. Ossakow, S. L.; Ott, E.; Haber, I. (Naval Research Lab., Washington, D. C.). Jul 1972. 49p. (NRL-MR-2468). NTIS.

Theoretical and computer simulation studies of whistler instabilities in anisotropic collisionless plasmas are presented. Initial bi-Maxwellian, Maxwellian with loss cone, and hot Maxwellian superimposed on a more dense cold isotropic background electron distributions were used. (auth)

20627 (AD-748222) IONOSPHERIC HEATING ANALYSIS. Interim technical report, 1 December 1971-31 May 1972. Gordon, W. E.; Carlson, H. C. (Rice Univ., Houston, Tex.). Jul 1972. Contract F30602-72-C-0278. 30p. (RADC-TR-72-208). NTIS.

The high-frequency radio heating of the ionosphere running from May 1-20 has produced some surprising observational evidence of enhancements associated with the extraordinary mode of the heating radiowave (previously all other enhancements have been excited by the ordinary mode), enhanced gyro lines, and of ionospheric "holes" burned by the heating transmitter. In the search for spectral features there has been discovered evidence for weak but measurable lines induced by the hf radio waves (O-mode) at the electron gyrofrequency and at twice the gyrofrequency. The ionospheric "holes" are seen as extra traces on the ionograms and can be checked against electron density profiles made with the heater on and off. The anomalous heating that produces large enhancements in the intensity of the plasma line continues to attract major attention. (NTIS)

20628 (AD-748311) HIGH-ALTITUDE PLASMA EFFECTS. Technical report, 28 February-25 July 1972. Arnush, D.; Fried, B. D.; Kennel, C. F.; Wong, A. Y. (TRW Systems Group, Redondo Beach, Calif.). 25 Jul 1972. 29p. (TRW-21961-6004-RO; RADC-TR-72-209). NTIS.

A Quiescent Uniform Ionospheric Plasma Simulator (QUIPS) was constructed to analyze and model the results of various field experiments in which a region of the ionosphere was artificially excited by a radar scattering. The general design considerations for the facility are reviewed, and a final design and fabrication schedule is presented. The current status of the construction as well as some of the preparations for the performance of the follow-on activities are described. (auth)

20629 (AD-748430) TOPSIDE IONOSPHERE DURING SUNRISE AT MIDLATITUDES. Soicher, H. (Army Electronics Command, Fort Monmouth, N. J.). Aug 1972. 142p. (ECOM-4000). NTIS.

Thesis.

The structure and variation of the topside ionosphere were determined for midlatitudes during the sunrise period, based on electron-density measurements obtained with the aid of Alouette I, the Canadian topside-sounder satellite. Electron-density profiles obtained from Alouette-I soundings recorded at various north American stations provide the basis for the determination of the scale-height of the electron-density distribution profiles. The scale-heights profiles, with proper physical assumptions, are interpreted in terms of the combined ion and electron temperatures and the relative ion concentration in the altitude range of 450 to 750 km. (auth)

20630 (AD-748880) OBSERVATION OF vlf PHENOMENA INSIDE THE AURORAL ZONE. Final report, 1 Apr 1968-31 May 1972. Swift, D. W.; Strivastava, R. N. (Alaska Univ., College. Geophysical Inst.). Jun 1972. Contract DAHC04-69-C-0054. 88p. (AROD-7942). NTIS.

The results of a three-year program of observations and analysis of very low frequency (vlf) radio emissions in the auroral zone are reported. The particular vlf emissions are vlf hiss, vlf chorus, and extra-low-frequency (elf) hiss. All of these emissions occur in the audio frequency range, and the nomenclature of these various emissions is derived from the sounds generated when the undetected signal is fed into a loudspeaker. (auth)

20631 (AD-749016) MEASUREMENTS IN SUPPORT OF THE OOSIK EXPERIMENT. Interim technical report, 1 February-1 May 1972. Carpenter, G. B. (Stanford Research Inst., Menlo Park, Calif.). May 1972. Contract N00014-72-C-0394. 20p. NTIS.

At 0659 GMT March 7, 1972 a shaped barium charge was released high above central Alaska by the Los Alamos Scientific Laboratory and the University of Alaska. In support of this experiment, known as OOSIK, Stanford Research Institute operated two existing radar facilities in Alaska. In addition, a low-frequency receiving site was established and operated near the down-field intercept of the barium release. A preliminary analysis of the data indicates that a magnetic substorm began 17 minutes after the injection and was accompanied by considerable auroral activity. A number of factors suggest that the substorm was not triggered by the barium injection but was of natural origin. If a magnetospheric instability was later triggered by the barium release its effects were masked by the natural event. (auth)

20632 (AD-749515) INVESTIGATION OF AURORAL IONOSPHERIC AND PROPAGATION PHENOMENA RELATED TO THE POLAR FOX II EXPERIMENT. Technical report, 15 August 1971-31 March 1972. Herman, J. R.; Vargas-Vila, R. (Massachusetts Inst. of Tech., Lexington. Lincoln Lab.). May 1972. Contract F19628-70-C-0230. 108p. (ESD-TR-72-213). NTIS.

Auroral phenomena can have pronounced effects upon hf radiowave propagation traversing polar regions. To further understand the implications and predict the resulting effects, a continuation of the investigation of auroral phenomena and their impact upon Polar Fox II measurements is presented. Special emphasis has been placed on a study of the fine structure and motions of spread F as related to spectral spreading; the main ionospheric trough and magnetic activity; analysis of radar auroral absorption and auroral sporadic E as they relate to propagation coverage predictions. (auth)

20633 (AD-749859) MODEL OF AURORAL SUBSTORM ABSORPTION. Elkins, T. J. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 18 Jul 1972. 23p. (AFCRL-72-413; AFCRL-ERP-404). NTIS.

High-frequency radio propagation at high latitudes is strongly affected by auroral absorption, which is known to occur sporadically in events known as auroral substorms. A brief discussion of the morphology of substorms is presented, followed by an analysis of auroral absorption during 60 substorms. The statistical parameters necessary to specify a predictive model are derived empirically as a function of time after substorm onset. Also presented from other evidence are relationships to model the latitude dependence, substorm duration, frequency dependence, and the seasonal and solar-cycle dependence. A brief discussion of structure size in auroral absorption events is included. (auth)

20634 (AD-750570) INVESTIGATION OF D-REGION IONIZATION DURING A POLAR CAP ABSORPTION EVENT. II. Final Report. Hale, L. C. (Pennsylvania State Univ., University Park. Ionosphere Research Lab.). Aug 1972. Contract DAAD05-69-C-0336. 30p. NTIS.

Data is presented for parachute-borne blunt probe, charged-particle, conductivity measurements during a PCA, covering a night-sunrise-day sequence of four shots on November 3, 1969 at Ft. Churchill, Manitoba. The measured conductivities show that the effects of the PCA on ionization persists down to about 30 km. A description of the propagation experiment flown with the blunt probe is presented. (auth)

20635 MAGNETOSPHERE-IONOSPHERE INTERACTIONS. Proceedings of the Advanced Study Institute at Dalseter, Norway, April 14-23, 1971. Folkestad, K. (ed.). Oslo; Universitetsforlaget (1972). vp. (CONF-710463-).

From Advanced Study Institute on Magnetosphere-Ionosphere Interactions; Dalseter, Norway (14 Apr 1971).

Abstracts were prepared for eight papers from the proceedings at the Advanced Study Institute on Magnetosphere-Ionosphere Interactions, Dalseter, Norway, 4/14-23, 1971. Behavior and properties for the ionosphere, magnetosphere, neutral sheet, plasmasphere, radiation belts, and ring current are discussed. One paper on the theory of vlf emissions appeared previously in NSA 26:51464. (JCW)

For abstracts of individual papers see: 20636-20639, and 20680-20683.

20636 MIDLATITUDE D-REGION IONIZATION ASSOCIATED WITH THE "SLOT" IN RADIATION-BELT ELECTRONS. Thorne, R. M. (Univ. of California, Los Angeles). pp 63-64 of Magnetosphere-Ionosphere Interactions. Folkestad, K. (ed.). Oslo; Universitetsforlaget (1972).

From Advanced Study Institute on Magnetosphere Ionosphere Interactions; Dalseter, Norway (14 Apr 1971). See CONF-710463–.

High-energy electrons are continuously removed from the radiation belts through resonant pitch-angle scattering by elf electromagnetic whistler-mode waves. Within the plasmasphere the naturally occurring elf turbulence shows no definite polarization and is confined to a relatively narrow band centered on a few hundred Hz. Parasitic cyclotron resonance of relativistic electrons with this wave turbulence readily accounts for the electron lifetimes and the spatial location of the "slot." Resulting precipitation fluxes indicate that this process must be considered as an important ionization source for the nocturnal D regions of the ionosphere. This precipitation source appears to be related to storm aftereffects. (auth)

20637 HIGH-LATITUDE IONOSPHERE ABOVE THE E LAYER. Hultqvist, B.; Liszka, L. (Kungliga Vetenskapsakademien, Kiruna, Sweden). pp 65-74 of Magnetosphere–Ionosphere Interactions. Folkestad, K. (ed.). Oslo; Universitetsforlaget (1972).

From Advanced Study Institute on Magnetosphere Ionosphere Interactions; Dalseter, Norway (14 Apr 1971). See CONF-710463–.

After a brief summary of the morphology of the upper polar ionosphere, the physical processes believed to be responsible for the morphology are discussed, namely: effects on the F layer (and above) of energetic-particle precipitation, winds, magnetic field-aligned currents, and electrostatic fields. (auth)

20638 HIGH-LATITUDE VARIATIONS OF F-REGION ELECTRON TEMPERATURE. Raitt, W. J.; Willmore, A. P. (University Coll., London). pp 75-82 of Magnetosphere–Ionosphere Interactions. Folkestad, K. (ed.). Oslo; Universitetsforlaget (1972).

From Advanced Study Institute on Magnetosphere Ionosphere Interactions; Dalseter, Norway (14 Apr 1971). See CONF-710463–.

Results of electron temperature measurements made on the satellite ESRO-IA over the N polar region are described. It is shown that during geomagnetically disturbed periods, and also during a particle event when "field-aligned" low-energy protons were observed, a broad zone of high temperatures develops with maximum temperatures at about 70° magnetic latitude. This shows little local-time dependence and is well correlated with the presence of energetic electrons. During the main phase of the storm, a second zone develops in the midnight sector at latitudes near the trace in the ionosphere of the plasmapause. No energetic particles are associated with this zone, in which the highest temperatures are observed. In the first zone, the electron density is enhanced relative to the value extrapolated from lower latitudes, while in the second it is diminished. Possible heating mechanisms in the two zones are discussed. (auth)

20639 PROPERTIES OF LOW-ENERGY PARTICLE IMPACTS IN THE POLAR DOMAIN IN THE DAWN AND DAYSIDE HOURS. Hoffman, R. A. (Goddard Space Flight Center, Greenbelt, MD). pp 117-138 of Magnetosphere–Ionosphere Interactions. Folkestad, K. (ed.). Oslo; Universitetsforlaget (1972).

From Advanced Study Institute on Magnetosphere Ionosphere Interactions; Dalseter, Norway (14 Apr 1971). See CONF-710463–.

In the dawn and dayside hours of the polar domain, two regions of electron precipitation have been identified: a very-high-latitude "soft zone" and a lower-latitude "hard zone." The electrons in the soft zone produce a large number of interesting phenomena, both above and in the ionosphere, such as the generation of vlf hiss, magnetic effects from the currents they constitute, electron concentration enhancement peaks at 1000-km altitudes, and the dayside auroral oval, with emissions predominantly at 6300 Å. Electron precipitation is continuously present in this zone. On the other hand, fewer phenomena appear associated with the lower-latitude hard zone, which exists through the morning hours to noon and is related to substorm activity. The higher-energy precipitating electrons (>50 keV) produce D-layer events. The lower-energy electrons (a few keV) produce the mantle aurora, but because of a likely energy dispersion from local time drift of the electrons originating in the midnight region, the morphology of E-layer absorption events is more difficult to observe. (auth)

20640 Vlf ATMOSPHERICS: THEIR MEASUREMENT AND INTERPRETATION. Harth, W. (Max-Planck-Institut fuer Radioastronomie, Bonn). Z. Geophys.; 38: No. 5, 815-849 (Nov 1972). (In German).

Measurement methods of vlf atmospherics are reviewed, and interpretations of the results are summarized. Analyzers are described and a simple schematic of the vlf atmospherics analyzer Type 3/70 is shown. Examples of the measurements of the spectral amplitude at 9 kHz and the group delay time difference (GDD) at 6 and 8 kHz are given. Derivation of the parameter GDD is presented. Effects of the July 8, 1968 solar flare are shown as determined from GDD and SAR registrations with the source located at the Stockert Station in Spain. The night-time enhancement of the GDD is shown for a source located east of the Stockert Station. A map is presented to show how the sources are located by GDD measurements from June 1 to Sept. 30, 1971. (63 references). (JCW)

20641 ANALYSIS OF THE PITCH-ANGLE DISTRIBUTION OF ENERGETIC ELECTRONS AND PROTONS MEASURED IN THE MORNING SECTOR OF THE AURORAL ZONE DURING ENHANCED PARTICLE PRECIPITATION. Stuedemann, W. (Max-Planck Institut fuer Aeronomie, Lindau/Harz, Ger.). Z. Geophys., 38: No. 5, 863-879(Nov 1972). (In German).

Measurements of protons in the energy range 180 keV to 2 MeV and electrons above 25 keV were performed on board two rockets during slowly varying particle precipitation on February 14, 1970. An isotropic pitch-angle distribution was observed for protons, whereas electrons showed rapid changes between isotropic and anisotropic distributions. This change usually was accompanied by an enhancement of the precipitation by more than two orders of magnitude. Isotropic distribution was reached at an intensity of about $7 \times 10^5/cm^2$ sec sr for electrons having energies above 45 keV. This confirms in principle a theory of the resonant interaction whistler-mode waves and electrons. (23 references). (auth)

20642 LONGITUDINAL EXTENSION OF ELECTRON PRECIPITATION DURING MAGNETOSPHERIC SUBSTORMS. Kremser, G. (Max Planck-Institut fuer Aeronomie, Lindau/Harz, Ger.); Korth, A.; Saeger, K. H.; Jensen, P. A.; Jensen, V. N.; Taagholt, T. Z. Geophys.; 38: No. 5, 851-862(Nov 1972).

Simultaneous measurements of auroral x rays at Kiruna (Sweden) and Narssarssuaq (Greenland) were used to investigate the large-scale longitudinal extension of the region, where electrons with energies above 40 keV are precipitated during magnetospheric substorms. The results indicate that the extension depends on local time and the phase of the substorm, being more restricted around the midnight meridian shortly after its onset. Later on, the precipitation can extend over distances of more than 3000 km in the evening-to-midnight sector of the auroral zone. As the result of two different magnetospheric processes, distances of the same order are also covered in the midnight-to-morning sector. In the recovery phase of a substorm, strong precipitation was observed in Greenland shortly after noon, but there was none in Scandinavia, which was then in the evening sector. Implications of the observations on the precipitation of electrons with energies above 40 keV are discussed. (auth)

20643 DETERMINATION OF THE HEIGHT OF IONOSPHERIC IRREGULARITIES WITH THE HOLOGRAPHIC METHOD. Schmidt, G. (Max-Planck-Institut fuer Aeronomie, Lindau/Harz, Ger.). Z. Geophys.; 38: No. 5, 891-913(Nov 1972).

For the determination of the height of ionospheric irregularities radio signals from the US transit navigation satellites at frequencies 150 and 400 MHz (3/8 harmonic) are received by a ground station. Using the reciprocity theorem, which has only limited validity in the ionosphere, it is shown that the mixture of both signals in the receiver forms the one dimensional scan of a radio hologram at the height of the satellite orbit. The radio hologram is made from the 400-MHz signal as reference signal and the 150-MHz signal as image signal. The one-dimensional scan describes the two-dimensional image of a plane. The projection rules used are given. The reconstruction of the image can be performed with laser light. In this work a simple filtering and numerical procedure is given with which the heights of irregularities can be approximately determined. In the continuation of this work it is planned to improve the accuracy of the height determinations by using laser light. For the first time it is possible to carry out height determinations of ionospheric irregularities from a single ground station. This work is an experimental contribution to the study of coupling effects between the magnetosphere and ionosphere and to the study of horizontal gradients in the electron density distribution in the polar ionosphere. (auth)

20644 CONTRIBUTION TO THE THEORY OF THE EQUATORIAL ELECTROJET. Gurevich, A. V.; Krylov, A. L.; Shcherbakov, V. P. (Lebedev Inst. of Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 366-373(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 413-420(1972).

Electric fields and currents in the low-latitude ionosphere are investigated. It is demonstrated on the basis of an analysis of equations for the potential electric field in the Earth's magnetosphere and ionosphere that the equatorial zone has a specific boundary layer that is characterized by a sharp change in the in-

tegral conductivity tensor. Analytical solutions are obtained for the field and currents in the boundary layer. It is shown that the electric current in this region increases sharply, forming the equatorial electrojet. (auth)

20645 PROPERTIES OF PLANE ASYMMETRIC PLASMA WAVEGUIDES AS APPLIED TO SHORT-WAVE PROPAGATION ALONG INHOMOGENEITIES OF THE TOPSIDE IONOSPHERE. Bukin, G. V.; Perekhvatov, Yu. K. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 374-379 (1972).

Translated from Geomagn. Aeron.; 12: No. 3, 421-426(1972).

E waves in a plane asymmetric plasma waveguide are investigated in relation to short-wave propagation along inhomogeneities of the topside ionosphere. Dispersion equations are derived and a method of computing the attenuation coefficient for a collisional plasma is described. It is demonstrated that nontransparent modes prevail in asymmetric plasma systems in contrast to symmetric ones. (auth)

20646 STRUCTURE OF IONOSPHERIC INHOMOGENEITIES ACCORDING TO SIMULTANEOUS OBSERVATIONS ON TWO MAGNETOIONIC COMPONENTS. Gusev, V. D.; Kashin, A. A.; Lan, N. B. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 380-382(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 427-430(1972).

A significant anisotropy in the scattering of rays in a gyrotropic turbulent medium was found experimentally. The kinematic characteristics of inhomogeneities are not associated with the difference in the scattering of magnetoionic components. (auth)

20647 IONOSPHERIC DISTURBANCES OF MARCH 6-10, 1970. Ben'kova, N. P.; Bukin, G. V.; Draitskii, V. M.; Zhulin, I. A. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 383-390(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 431-439(1972).

The magnetic-ionospheric disturbance of March 6-10 was a large magnetic storm with several substorms superposed on it. The storm was produced by a flare with a broad spectrum of geophysically effective radiation: x-ray and uv, a flux of fast protons, and ordinary corpuscular streams. The proton fluxes produced polar-cap absorption and the corpuscular stream produced a ring current and a planetary change of the F2 region. The substorms were accompanied by the precipitation of magnetospheric particle fluxes into the lower ionosphere and the energy spectra of the particles and the effects caused by them in the lower ionosphere differed for the substorms at 19, 20, and 21h UT. This difference was produced to a large extent by the storm phase. (JCW)

20648 POSSIBILITY OF ESTIMATING THE FLUX OF ENERGETIC PARTICLES IN THE IONOSPHERIC D REGION AT SUNRISE AND DURING THE DAYTIME. Nestorov, G. (Geophysical Inst., Sofia). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 391-395(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 440-445(1972).

The contribution of solar corpuscular streams to the ionization of the lower ionosphere is estimated on the basis of a quasi-exponential electron-density distribution in the ionospheric D region and absorption data. (auth)

20649 DYNAMICS OF AURORAL ABSORPTION. Driatskii, V. M.; Shumilov, O. I.; Frank-Kamenetskii, A. I. (Arctic and Antarctic Scientific Research Inst., Leningrad). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 396-400(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 446-452(1972).

The data from the riometer network in the Arctic are used to construct an average scheme of the global motion of the auroral absorption region. The data obtained testify to motion in the longitudinal and latitudinal directions. It is demonstrated that the motion of auroral absorption is produced by electron drift not only eastward, but also westward. (24 references) (auth)

20650 SPORADIC IONIZATION OF THE IONOSPHERIC E REGION AT HIGH LATITUDES AS A FUNCTION OF MAGNETIC ACTIVITY. Besprozvannaya, A. S.; Shchuka, T. I. (Arctic and Antarctic Scientific Research Inst., Leningrad). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 401-404(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 453-457(1972).

The relationship between magnetic activity and sporadic E-region ionization is investigated from data of the global network of vertical sounding stations at high latitudes for all seasons of 1958 and the winter of 1963-1964. It is demonstrated that the sign of the relationship between these two characteristics is determined by station location and the time of day. A region is distinguished where the probability of E_S appearance increases with magnetic activity. This region has the form of an oval, the northern boundary of which coincides with the position of the boundary of closed geomagnetic lines of force. The difference in the morphological characteristics of E_S ionization in the polar cap and in the oval zone suggests a different mechanism of E_S formation in these regions. (auth)

20651 BREMSSTRAHLUNG X RAYS IN THE STRATOSPHERE AND AURORAL ACTIVITY ON JANUARY 21 AND FEBRUARY 3, 1969. Novikov, A. V.; Sokolov, V. D.; Shafer, Yu. G.; Nadubovich, Yu. A.; Lyutenko, V. F.; Kirienko, O. V. (Inst. of Cosmophysical Investigations and Aeronomy, Yakutsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 415-418(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 468-472(1972).

Two x-ray bursts in the stratosphere over Tixie, one during a large global storm and the other during a substorm, are analyzed. The relationship of bremsstrahlung x-rays with glow and the shape of auroras and cosmic radio-noise absorption is investigated. The flux of injected electrons is estimated. (auth)

20652 POLARIZATION OF Pc5 PULSATIONS. Van'yan, L. L.; Turbin, Yu. G.; Abramov, L. A. (Inst. of Nuclear Space Research, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 441-444(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 498-502(1972).

Data from the global network of magnetic observatories are used to demonstrate that an inversion of the sense of rotation of the horizontal vector occurs for Pc5 pulsations in the maximum amplitude zone on the day side of the Earth. The polarization of these pulsations is linear at low latitudes. Four regions with a predominant polarization characteristic are singled out statistically. It is found that conductivity irregularities in the ionosphere have no effect on the sense of rotation of the vector of a Pc5 disturbance. (auth)

20653 TIME AND SPACE DISTRIBUTION OF THE INTENSITY OF EXCESS RADIATION IN THE EQUATORIAL REGION. Tsaplin, V. S.; Zubareva, L. V. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 474-475(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 536(1972).

Satellites were flown at an apogee of ~350 km and a perigee of ~200 km from July 1965 to March 1969, 80% of the time below the radiation belts, recording the direct passage of electrons with an energy $\gtrsim 8$ Mev and protons $\gtrsim 60$ MeV. The method for determining the time and space distribution of the intensity of the excess radiation in the equatorial region is discussed. Results show that excess radiation is a secondary component, generated by cosmic-ray particles in the Earth's atmosphere and the satellite body. (JCW)

20654 CHARACTERISTICS OF THE vlf-NOISE SPECTRUM DURING EXCITATION OF THE EARTH-IONOSPHERE RESONATOR BY COSMIC SOURCES. Nikolaenko, A. P. (Inst. of Radio Physics and Electronics, Kiev). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 405-410(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 458-463(1972).

An expression is obtained for the vlf-noise spectrum during excitation of the Earth-ionosphere resonator from space. It is demonstrated that under certain conditions cosmic sources with a smooth spectrum excite vlf oscillations in a cavity with a strongly dissected energy spectrum. The results are compared with experimental data obtained at high latitudes. (auth)

20655 INVESTIGATION OF NONSTATIONARY PROCESSES IN THE IONOSPHERE AND SPACE WITH QUANTUM FREQUENCY STANDARDS. Ivan-Kholodyni, G. S.; Korchak, A. A.; Lobachevskii, L. A.; Stakhanov, I. P.; Chikhachev, B. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 353-359(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 398-406(1972).

It is demonstrated that the use of quantum frequency standards on satellites broadens the range of application of phase methods for measuring nonstationary phenomena in the ionosphere, magnetosphere, and near-Earth space if the delay of strongly frequency-stabilized radio signals is recorded. If a special method of excluding the Doppler effect is used, it is possible to measure the first and second time derivatives of electron density in a column of unit cross section for various parts of the ionosphere and interplanetary medium. (auth)

20656 MEASUREMENT OF THE INTEGRAL PARAMETERS OF THE NIGHTTIME IONOSPHERE FROM OBSERVATIONS OF INTERCOSMOS-2 SIGNALS. Solodovnikov, G. K.; Migunov, V. M.; Vladimirova, G. V.; Vorontsov, Yu. F.; Yagovkin, A. R. Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 479-480 (1972).

Translated from Geomagn. Aeron.; 12: No. 3, 541-542(1972).

The phase difference and angle of rotation of the polarization plane of signals from a "Mayak" radio station on Intercosmos 2 were measured on coherent frequencies of 20 and 30 MHz in Kharkov in January–February 1970. The satellite altitude varied from 600 to 1000 km. The nonstationarity of the total number of electrons is shown by comparisons of data from the Intercosmos data, Explorer-22 data, and some ground data, and is shown to be small at any solar-activity level and increases sharply with dawn. (JCW)

20657 NONSTATIONARY DISTRIBUTION OF THE ELECTRON–ION GAS IN THE IONOSPHERE. Khantadze, A. G.; Khocholava, G. M.; Mebagishvili, N. N. (Inst. of Geophysics, Tbilisi, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 481-483(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 543-544(1972).

The space–time distribution of electron density in the ionospheric F region is determined by the combined effect of ionization, recombination, and plasma transport by ambipolar diffusion, and vertical and horizontal drifts. An important fact in this combination of physical processes is charged-particle transport, which plays an important role in the F region where the mean free path and lifetime of charged particles increase rapidly with height. The equation describing the state of ionization at a given instant of time and at a given height is presented, and is solved under various simplifying assumptions. A computation of the relaxation time agrees well with some vertical sounding data. (JCW)

20658 D_{st} VARIATION OF ELECTRON DENSITY AT THE F2 LAYER MAXIMUM ON THE NOON MERIDIAN. Besprozvannaya, A. S. (Arctic and Antarctic Scientific Research Inst., Leningrad). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 483-485(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 545-574(1972).

Variations at the F2-layer maximum during a magnetic storm were determined for a fixed position with respect to the Sun rather than for all hours of the day, using vertical sounding data. An investigation was made of the electron density variations at the F2-layer maximum on the noon meridian. Noon Δf_0F2 values for 36 stations in the Northern Hemisphere, located in the interval of invariant latitudes 40 to 65° (L = 1 to 4), were used. The ring current responsible for the development and formation of the main storm phase is known to form within these values of L. (JCW)

20659 CORRECT STATEMENT OF THE PROBLEM OF COMPUTING THE N(h) PROFILES OF THE LOWER IONOSPHERE. Gulyaeva, T. L. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 488-490(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 551-552(1972).

Lack of experimental data on underlying and interlayer regions in the ionosphere presents the major difficulties in the determination of N(h), and is the main reason for indeterminacy of the solutions obtained. All known methods of computing N(h) make some assumptions regarding the behavior of ionization in unobserved regions, so that only one among many possible solutions is determined. It is demonstrated that using the minimum of unknown parameters in the underlying and interlayer regions, one can estimate from two components on an ionogram the dimensions of these regions and obtain an explicit N(h) distribution in observed ionospheric layers. (JCW)

20660 VARIATIONS OF THE WINTER ANOMALY IN THE SOLAR ACTIVITY CYCLE. Vasil'eva, E. K. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 490-491(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 553(1972).

A review of previous experiments reveals distinct correlations that a winter radio-wave absorption anomaly exists. There is no consensus regarding the dependence of the winter anomaly on solar activity. The behavior of f_{min} over an 11-year period (1957 to 1968, excluding 1960) in Moscow was investigated. Winter absorption varies from year to year. It reached a maximum in 1957 to 1959, gradually decreased to a minimum in 1964 to 1965, and then started to increase again from 1966. In 1957 to 1961, there were many days with f_{min} exceeding 2.0 MHz, whereas in 1963 to 1965 there were very few such days, even in winter. Therefore, the winter anomaly correlates with solar activity, as does absorption in general, and increases in years of maximum solar activity. (JCW)

20661 ESTIMATING RADIO-WAVE ABSORPTION BY THE Al METHOD. Khmel'nitskii, E. A. Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 492-493(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 554-556(1972).

When radio-wave absorption is estimated from the measured level of a signal reflected from the ionosphere in vertical sounding (Al method) it is assumed that the virtual signal reflection heights in the ionosphere do not differ significantly in various seasons. Another assumption is made while analyzing the results of these measurements, namely that the N(h) profiles (in those parts of the ionosphere that are crossed by the ray trajectory) vary with the solar zenith angle in such a manner that new N values can be obtained by multiplying the former values by a quantity that is independent of h. In other words, assumption is necessary to determine the seasonal absorption pattern from the measured signal levels. The second assumption must be satisfied to find (as usually done) the dependence of total absorption on the solar zenith angle (on cos χ). Experimental data are described that show that the first assumption is not always valid and the second is not justified at all. It is concluded that in absorption measurements by the Al method, absorption should be measured instead of the received signal level, considering that: absorption has a practically invariable part in the course of a season, which is manifest after sunrise and disappears after sunset; and the upper reflection boundary in winter can change to such an extent that this change must be taken into account in the interpretation of the results of measurements. (JCW)

20662 BRIEF INTEGRAL AURORAL EMISSION BURSTS. Kuzakova, L. P. (Inst. of Cosmophysical Investigations and Aeronomy, Yakutsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 496-497(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 560(1972).

An investigation was made of the temporal variations of the frequency of appearance of auroral bursts on electrophotometer records at Tixie from Sept. 1959 to March 1970. A total of 1092 bursts was recorded in 10,450 hours of observation. The brief signal peaks have the characteristics of short-duration bursts, but there was a possibility that the peaks on the records might have been noise. There was good agreement between the temporal variations of the frequency of light flux bursts and variations in auroral activity suggesting that the peaks on the records are a special class of auroral phenomena rather than noise. Sometimes these bursts were received simultaneously at two stations a distance of 500 to 1000 km apart indicating that the bursts are not noise, but a phenomenon of large spatial scale. (JCW)

20663 NOCTURNAL INTENSITY VARIATIONS OF 6300-A EMISSION UNDER QUIET GEOMAGNETIC CONDITIONS. Truttse, Yu. L. (Inst. of Atmospheric Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 498-500(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 561-563(1972).

Electrophotometric data obtained during the ICY and IQSY by the global station network were used to investigate the nocturnal intensity variations of 6300-A emission under quiet geomagnetic conditions. Barbier's formula that gives relatively good results over short periods of time in the first half of the night is generally unsuitable. Data were analyzed for 2970 nights in 1957–1959 at 10 stations. The method of data analysis was developed on the assumption that the ^1D level of atomic oxygen at night under quiet geomagnetic conditions is populated mainly as a result of dissociative recombination and excitation by photoelectrons appearing both at the observation and conjugate points. Results of the analyses compared with measurements show that it is possible to determine the intensity of red oxygen emission I_{6300} and its nocturnal variations under quiet conditions with sufficient accuracy. (JCW)

20664 REGULAR AURORAL AND MAGNETIC FIELD INTENSITY FLUCTUATIONS. Raspopov, O. M.; Roldugin, V. K. Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 502-504 (1972).

Translated from Geomagn. Aeron.; 12: No. 3, 566-567(1972).

Relationships between the excitation of auroral and geomagnetic-field pulsations were observed, but no correlations were concluded. It is known that the processes develop simultaneously, but independently. A correlation cannot be correctly reached because different methods are employed to record the signals. A photometer records the emission intensity of a limited portion of the sky and magnetometers record the field of the current system associated with this emission. An investigation is made of regular auroral intensity pulsations in the range of periods of geomagnetic Pc-4 pulsations during the regular 70-sec pulsations of airglow intensity records in the morning of Feb. 27, 1969, at Loparskaya. The early morning auroral intensity pulsations were closely correlated with stable geomagnetic pulsations. (JCW)

20665 POSSIBLE ACCELERATION OF AURORAL ELECTRONS BY THE ELECTRIC FIELD OF PULSATIONS. Barsukov, V. M.; Van'yan, L. L.; Pudovkin, M. I. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 504-505(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 568(1972).

The model of Barsukov and Pudovkin, 1970, was used to estimate the density of longitudinal currents and the magnetic field intensity of pulsations under the auroral electrojet, δH. The auroral electrojet was assumed to be $\delta H \sim 20\ \gamma$ in the equatorial plane of the magnetosphere at $L \sim$ (5 to 6) R_E. Calculations are made for quiet (may be disregarded) and disturbed times. The potential difference is calculated corresponding to the length of a line of force from the summit to the ionosphere, and is sufficient for a 10% modulation of electrons with an energy $U_0 \sim 1$ keV. The acceleration of electrons by the longitudinal electric field of pulsations under anomalous conductivity conditions can explain the appearance of pulsating auroras. (JCW)

20666 TYPE VARIATION OF SOLAR SUDDEN FIELD ANOMALY (SFA) ON 164 kHz AS AN INDICATOR OF SEASONAL STRUCTURE CHANGES IN THE D-REGION. Letfus, V. (Astronomical Inst., Ondrejov, Czech.); Apostolov, E. M.; Nestorov, G. J. Atmos. Terrest. Phys.; 35: No. 3, 571-576(Mar 1973).

Two main forms of sudden field anomalies (SFA) occur on 164 kHz for the long distance paths of skywave propagation. The first one with the negative initial impulsive phase is observed in the winter period of the year, the second one with the positive phase in the summer period (Nestorov, Compt. rend. Acad. Sci. Bulg., 17: 1009(1964)). This is in contradiction with Mitra's explanation (Solar Phys., 15: 249(1970)), that the SFA forms are dependent on the hardness, i.e., on the shape of the spectrum of x-ray bursts. 308 SFA effects detected for the Allouis–Sofia path have been investigated from May 1969 to March 1971 in this paper. A comparison has been done with the spectral index, derived for the corresponding x-ray bursts, measured on the satellites Vela V and VI in the spectral ranges 0.3 to 3 Å and 1 to 8 Å. The analysis demonstrates that no differences exist in the spectral distribution of x-ray bursts for the SFA effects with the positive and the negative phases. Because no interferences of long radiowaves for long distance paths by the skywave propagation occur, the only explanation is the seasonal structure changes in the lower D region. It confirms the conclusions given earlier by Nestorov (1964). (auth)

20667 MONTE CARLO SIMULATION OF A MODEL IONOSPHERE. 2. Energy Flow and Energy Dissipation. Schlegel, K. (Max-Planck-Institut fuer Aeronomie, Lindau/Harz, Ger.). J. Atmos. Terrest. Phys.; 35: No. 3, 415-424(Mar 1973).

Some effects of energy flow and energy dissipation in an ionospheric model simulated with the Monte Carlo method were calculated. In this model, which is described in detail in a previous paper (Schlegel, J. Atmos. Terr. Phys., 33: 1923(1971)), the trajectories of photons with a wavelength between 10 and 1027 Å, and the following photoelectrons, were traced through the atmosphere between 1000 and 120 km. Height-dependent values of the electron and the neutral-gas heating efficiency were presented. For the latter quantity a photon wavelength dependence is also given. The calculations were performed for a case of low and a case of high solar activity. (auth)

20668 INFLUENCE OF NEGATIVE-ION CHANGES IN THE D-REGION DURING SUDDEN IONOSPHERIC DISTURBANCES. Thomas, L.; Gondhalekar, P. M.; Bowman, M. R. (Radio and Space Research Station, Ditton Park, Eng.). J. Atmos. Terrest. Phys.; 35: No. 3, 385-395(Mar 1973).

A negative-ion model described by (Thomas et al., (J. Atmos. Terr. Phys.; 32: 1609(1973)) has been used to study numerically the changes in negative-ion composition and electron concentrations at representative heights during a flare-like enhancement of ion pair production rate. The importance of photodetachment of electrons from major negative ions in these flare-like changes is examined. Particular attention is paid to the delay between the peak of production and the maximum electron and ion concentrations, and to the decrease of concentrations during the recovery following the flare. (auth)

20669 NEGATIVE-ION COMPOSITION OF THE DAYTIME D-REGION. Thomas, L.; Gondhalekar, P. M.; Bowman, M. R. (Radio and Space Research Station, Ditton Park, Eng.). J. Atmos. Terrest. Phys.; 35: No. 3, 397-404(Mar 1973).

Recent laboratory measurements of negative-ion reactions are reviewed and used to formulate a model for the normal daytime D-region. Photodetachment of electrons from major negative ions is shown to be necessary in order to account for the daytime electron concentrations observed below 70 km. (auth)

20670 STRUCTURE OF THE ATMOSPHERE UP TO 150 KILOMETERS. Groves, G. V. (University Coll., London). Contemp. Phys.; 14: No. 1, 1-24(Jan 1973).

New techniques and organized observing programmes have maintained the impetus to geophysical research provided by the IGY in 1957 to 1958. A selection of research techniques and results are discussed that illustrate this statement. Meteorological rockets and satellites, sounding rocket observations, high-latitude phenomena, and upper atmosphere structure are the main topics dealt with. Reference is made to a new COSPAR International Reference Atmosphere (CIRA 1972) that reviews and tabulates atmospheric structure above 25 km and brings the material of the previous (1965) edition up to date. (auth)

20671 AURORAL-ZONE X-RAY MEASUREMENTS AT KIRUNA IN 1970. Saeger, K. H. (Max-Planck-Institut fuer Aeronomie, Lindau/Harz, Ger.); Kremser, G.; Pfotzer, G.; Specht, H.; Riedler, W. SPARMO Bull.; 5: No. 1, 71-79(Aug 1972).

The 1970 balloon program involved x-ray measurements in connection with auroral-zone crossings of the German Research Satellite AZUR. The purpose of these correlated measurements is to analyze in detail the relation between the temporal behavior of the precipitated electrons at a fixed location (balloon) with latitude profiles of >40-keV electrons (satellite). (Fr.)

20672 DEPTH OF FRAUNHOFER LINES IN THE GLOW OF THE DAYTIME SKY. Pavlov, V. E.; Teifel, Ya. A.; Golovachev, V. P. (Astrophysical Inst., Alma-Ata, USSR). Dokl. Akad. Nauk SSSR; 207: No. 3, 566-568(21 Nov 1972). (In Russian).

A decrease in depth of the Fraunhofer lines in the daytime or twilight spectra in comparison with the nighttime spectrum had previously been noted (J. R. Grainger, 1962). Measurements of brightness and the polarization of light were conducted at the wavelengths H (396.8 mμ), K (393.4 mμ), L (382.0 mμ), and N (358.1 mμ) during the daylight hours, at an altitude of 1450 m and at sea level. The decrease in depth of the Fraunhofer lines was maximum at the K line, and minimum at the L line. The spectrum of the daytime sky was investigated to determine the redistribution of energy with frequency of the light. (KSW)

20673 ION COMPOSITION IN THE E- AND LOWER F-REGION ABOVE KIRUNA DURING SUNSET AND SUNRISE. Kopp, E.; Eberhardt, P.; Geiss, J. (Univ., Bern). Planet. Space Sci.; 21: No. 2, 227-238(Feb 1973).

A magnetic-type mass spectrometer has been flown on two ESRO sounding rockets from ESRANGE (Kiruna 68°N) on February 25 and 26, 1970. The first launch was at sunset (16:33 UT) and the second the next morning, during sunrise (04:47 UT). For both flights the solar zenith angle was approximately 98°. The instrument was measuring simultaneously the neutral gas and positive ion composition and the total ion density. The results of the ion composition measurements are presented. For both flights the main ion constituents measured between approximately 110 to 220 km were O^+, NO^+, and O_2^+. Only at sunset were N^+ and N_2^+ detected above 200 km. In spite of the identical solar uv radiation, pronounced sunset/sunrise variations in the positive ion composition were found. The total ion densities at sunrise were between 5×10^3 and 5×10^4 ions cm^{-3} and therefore too high to be explained without a night-time ionization by precipitated particles. At sunrise the NO^+ and O_2^+ profiles show a correlated wavelike structure with three pronounced almost equally spaced layers in the E region. Only the highest layer is present in the O^+ profile. Locally enhanced field-aligned ionization originated by particle precipitation and an $E \times B$ instability are the most likely source for this structure. In the E and lower F regions the NO^+/O_2^+ ratio increased overnight from values around 7 at sunset to 15 at sunrise, correlated with an increase of the local magnetic activity index K from O^+ to 2°. This could be explained if the NO density and magnetic activity are correlated. (auth)

20674 ENHANCED ENERGETIC ELECTRON INTENSITIES AT 100 km ALTITUDE AND A WHISTLER PROPAGATING THROUGH THE PLASMASPHERE. Rycroft, M. J. (Univ. of Southampton, Eng.). Planet. Space Sci.; 21: No. 2, 239-251(Feb 1973).

During the flight of a Petrel rocket, instrumented by the SRC Radio and Space Research Station with Geiger counters and launched westwards from South Uist, Outer Hebrides, Scotland (L = 3.38), a transient increase was observed in the intensity of energetic electrons having pitch angles between 60 and 120°. The increase, by a factor of 20 above the quasi-steady intensity observed throughout the remainder of the flight, occurred in 0.8 sec and was simultaneous for both >45 and >110 keV electrons. Recorded ~0.5 sec later, on the ground, was a two-hop whistler. During the enhanced electron intensity event, the entire duration of which was ~6 sec, the four-, six- and eight-hop whistlers were also received. From an analysis of the whistlers' spectrogram, it is concluded that the whistlers were ducted through the magnetosphere along the $L = 3.3 \pm 0.1$ field line; the electron density in the equatorial plane is found to be 330 ± 10 cm^{-3}, a value characteris-

tic of conditions within the plasmapause. It is suggested that these temporally and/or spatially associated phenomena, rather than arising by a chance coincidence, were the result of a gyroresonant interaction between energetic electrons and whistler-mode waves moving in opposite directions. For gyroresonance on this field line at the equator, the parallel component of energy of the electrons is 25 keV at 3 kHz in the whistler band, or 100 keV at 1 kHz below it. It is suggested that a magnetospheric event occurred, causing both sudden enhanced electron precipitation and favorable conditions for the propagation and/or amplification of whistlers. A possible explanation is that energetic electrons, having a sufficiently anisotropic distribution function and associated with those injected during an earlier auroral substorm, become unstable via the transverse resonance instability when they drift into the plasmasphere, a region of high-density thermal plasma. (auth)

Effects of Nuclear Detonations

Refer also to abstract 20678.

20675 (FOA-3-3754-A-3) INFLUENCE OF HIGH-ALTITUDE NUCLEAR EXPLOSIONS ON RADIO COMMUNICATIONS. Ladell, L. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Feb 1972. 45p. (In Swedish). Dep. NTIS (U. S. Sales Only).

Experiments with nuclear explosions in the ionosphere are known to cause anomalous propagation effects for several days. Short-wave communications are particularly affected, with blackout for longer or shorter times. It is shown quantitatively how short- and long-wave radio propagation are affected by a high-altitude nuclear explosion. Two 1-Mt nuclear explosions at a height of 400 km are assumed, one during day and the other during night. At short-wave radio communications there will be blackout for about 2 hours at 11 MHz during day and 5 hours at 2 MHz during night. Even if the explosion yield or the explosion height is changed, there will be a short-wave blackout for some time, enough to seriously disturb important radio communications. At long-wave propagation there is a tendency that the ionospheric wave will decrease after the explosion. Systems based on the ground wave, e.g., if navigation aids, will thus be less affected. (auth)

Magnetospheric Phenomena

Refer also to abstracts 20533, 20586, 20631, 20635, 20642, 20654, 20655, and 20674.

20676 (AD-749815) GEOPHYSICS AND SPACE DATA BULLETIN. Volume IX, Number 2. Second quarter 1972. Carrigan, A. L. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). Sep 1972. 328p. (AFCRL-72-502; AFCRL-SR-145). NTIS.

The Bulletin is a quarterly publication that contains AFCRL contract and inhouse data reported from sites throughout the world. The following types of data are contained within each issue: magnetometer, cosmic ray, elf noise, riometer, solar optical and radio emission, and ionosonde. This issue covers such data for April, May, and June 1972. (auth)

20677 (AD-749866) ENHANCEMENT OF 0.24- TO 0.96-MeV TRAPPED PROTONS DURING THE 25 MAY 1967 MAGNETIC STORM. Rothwell, P. L.; Katz, L. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 17 Jul 1972. 22p. (AFCRL-72-146; AFCRL-ERP-406). NTIS.

During the large May 25, 1967 magnetic storm, a solid-state detector spectrometer, aboard the polar-orbiting satellite OVI-9, measured 0.24- to 0.96-MeV protons. A nonadiabatic, semipermanent enhancement of protons was observed following the storm in the region $2.50 < L < 3.25$, $B = 0.10 \pm 0.02$, at LT = 1800 hr. The 0.265-MeV proton flux increased by about a factor of 25, while the 0.885-MeV proton flux increased by a factor of 4 to 5. (auth)

20678 (AD-750474) TIME DEPENDENCE OF THE TRAPPED PROTON ENERGY SPECTRUM AT LOW ALTITUDES. O'Friel, Z.; Filz, R. C. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 15 Jun 1972. 16p. (AFCRL-72-397; AFCRL-PSRP-498). NTIS.

Measurements were made of the energy spectra of high-energy trapped protons utilizing nuclear emulsions exposed on low-altitude polar-orbiting satellites. The spectra are compared with those obtained by Heckman and Nakano (1969) at solar minimum and the effects of solar-cycle atmospheric density changes are evaluated. (auth)

20679 MAGNETIC FIELDS AND PARTICLE CURRENTS IN THE GEOMAGNETIC TAIL. Bird, M. K. Lawrence, KS; Univ. of Kansas (1972). 228p. University Microfilms Order No. 73-1846.

Thesis (Ph. D.).

A magnetic field and current configuration that is magneto-hydrodynamically and adiabatically self-consistent is constructed with the boundary conditions expected to hold in the geomagnetic tail. This field/current configuration is compared with the real magnetotail as observed by satellite. The fields and currents are said to be self-consistent in this sense if the contributions from all drift and magnetization currents form a current that is given by curl $\vec{B}$ at all points. (TSS) (Diss. Abstr., Int. B)

20680 THEORY FOR ENERGETIC ELECTRON LIFETIMES WITHIN THE PLASMASPHERE. Lyons, L. R. (Univ. of California, Los Angeles). pp 57-61 of Magnetosphere-Ionosphere Interactions. Folkestad, K. (ed.). Oslo; Universitetsforlaget (1972).

From Advanced Study Institute on Magnetosphere Ionosphere Interactions; Dalseter, Norway (14 Apr 1971). See CONF-710463-.

The removal of radiation-belt electrons through pitch-angle scattering by the observed obliquely propagating plasmaspheric whistler wave band is investigated. Electron lifetimes are calculated as a function of L and energy. The effects of high-latitude interactions and of oblique wave propagation with the resulting diffusion at all cyclotron harmonics are quantitatively incorporated into the calculations. The inclusion of these effects appears to extend the role of whistler-driven electron pitch-angle diffusion to provide an explanation of the positioning of the quiet-time radiation-belt electron slot and the electron losses within the slot region. (auth)

20681 HIGH-LATITUDE PARTICLE PRECIPITATION AND SOURCE REGIONS IN THE MAGNETOSPHERE. Eather, R. H. (Boston Coll., Chestnut Hill, MA); Mende, S. B. pp 139-154 of Magnetosphere-Ionosphere Interactions. Folkestad, K. (ed.). Oslo; Universitetsforlaget (1972).

From Advanced Study Institute on Magnetosphere Ionosphere Interactions; Dalseter, Norway (14 Apr 1971). See CONF-710463-.

Averaged properties of precipitating auroral protons and electrons (as deduced photometrically) are compared with direct satellite measurements of similar parameters. The various distinct types of precipitating particles are defined and related to their source regions in the magnetosphere. There are two distinct types of proton precipitation. On the nightside, the proton aurora locates equatorward of electron aurora before midnight and overlaps electron aurora after midnight. The most probable source region in the magnetosphere is the ring current, and gradient drift may sometimes extend this region through the dusk meridian and as far around as midday. There is a second, higher-latitude zone of soft-proton precipitation on the dayside that has its origin in magnetosheath plasma penetration through the cusp region. There are three distinct types of electron precipitation. On the nightside, there is a broad zone of soft (~1 keV) precipitation that extends from the equatorward side of the nightside oval and up to invariant latitudes of ~80°; the probable source region is the plasma sheet via loss-cone drizzle. The auroral oval on the nightside is generated by higher-energy (~5 keV) electrons that superimpose on the low-latitude side of the soft zone. The most probable source region in the magnetosphere locates between the inner edge of the plasma sheet and the center of the plasma sheet (near neutral sheet) in the tail. Gradient drift of these electrons extends this region through the dawn meridian and past noon, resulting in a precipitation region locating just equatorward of the dayside oval. The third region of electron precipitation coincides with the high-latitude dayside protons and results from very soft magnetosheath electrons (≲300 eV) penetrating the cusp regions. It is these soft dayside electrons that generate the dayside oval. These multiple zones of particle precipitation comprise a much more complex picture than the simple concept of the auroral oval would suggest, but provide a basis for clearer understanding of high-latitude precipitation phenomena. (auth)

20682 STORM-TIME INSTABILITIES OF THE RING CURRENT. Thorne, R. M. (Univ. of California, Los Angeles). pp 185-202 of Magnetosphere-Ionosphere Interactions. Folkestad, K. (ed.). Oslo; Universitetsforlaget (1972).

From Advanced Study Institute on Magnetosphere Ionosphere Interactions; Dalseter, Norway (14 Apr 1971). See CONF-710463-.

The resonant cyclotron instability between radiation-belt protons and ion-cyclotron waves can account for many observed features of the magnetospheric ring current. Analogous results apply to the electron-whistler interaction although the former are not considered to be important for ring-current energetics. Particles with energy exceeding 100 keV are readily destabilized

throughout the entire magnetosphere and their fluxes are consequently limited to the stably trapped levels described by Kennel and Petschek. However, at the dominant ring-current energies between 10 and 100 keV, a broad zone of stability exists in the region just outside the plasmapause. Particles injected into this outer zone during substorms may remain trapped for many drift orbits, allowing an intense ring current to develop. In direct contrast, this stable ring-current zone is bounded by regions of rapid precipitational loss within the plasmasphere and at large radial distance in the auroral zone. During geomagnetic storms much of the ring-current energy is dissipated into ion-cyclotron turbulence in a narrow zone just within the plasmapause. Throughout, the main phase proton lifetimes approach the strong diffusion limit of one hour in agreement with the observations of Frank. Protons injected from the magnetospheric tail are removed before they can drift to the dayside of the magnetosphere thus producing a strongly asymmetric ring current. After the cessation of substorm-associated injection events, the protons form a symmetric ring current and their subsequent removal is controlled by the outward expansion of the plasmapause. During this rapid phase of the storm recovery, the intense zone of ion-cyclotron turbulence provides the energy source to excite SAR arcs along the expanding plasmapause. Further decay takes place on a charge-exchange time scale of a few days. Relativistic electrons and high-energy protons will also be subjected to rapid parasitic pitch-angle scattering through resonant cyclotron interactions with the intense ring-current-generated ion-cyclotron turbulence. Precipitation of such particles near the strong diffusion limit is therefore expected to occur in association with low-energy proton dumping and SAR arc generation just inside the plasmapause. (auth)

20683 SOME PROPERTIES OF MAGNETIC NEUTRAL-SHEET SYSTEMS. Cowley, S. N. H. (Imperial Coll. of Science and Tech., London). pp 227-243 of Magnetosphere–Ionosphere Interactions. Folkestad, K. (ed.). Oslo; Universitetsforlaget (1972).

From Advanced Study Institute on Magnetosphere Ionosphere Interactions; Dalseter, Norway (14 Apr 1971). See CONF-710463–.

The basic properties of a neutral-sheet configuration are investigated via self-consistency between the current and the magnetic field, conservation of energy and momentum, and charge neutrality in the field-reversal region. Conservation of momentum implies a varying sheet thickness across the width of the system, as does the condition for charge neutrality. Using a model magnetic field, the thickness of the sheet is calculated, and good agreement between the two calculations is obtained. The sheet thicknesses are then interpreted in terms of the electric-field structure. (auth)

20684 ELECTRON AND PROTON ACCELERATION IN THE OUTER REGIONS OF THE MAGNETOSPHERE DURING POLAR SUBSTORMS. Kuznetsov, S. N.; Sosnovets, E. N.; Tverskaya, L. V.; Tel'tsov, M. V.; Khorosheva, O. V. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 426-428(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 481-484(1972).

Molniya-1 data are used to investigate the sudden appearance of fluxes of electrons with $E_e > 40$ keV and protons with $1 < E_p < 5$ MeV at $L > 10$. Their appearance correlates well with an increase in geomagnetic disturbance at high latitudes. The results are interpreted in the framework of Axford's hypothesis on the broadening of the auroral oval when lines of force reconnect in the tail of the magnetosphere and show that this reconnection can be accompanied by charged-particle acceleration to energies of ~1 MeV. (auth)

20685 DEVELOPMENT OF THE PINCH EFFECT IN THE EARTH'S MAGNETOSPHERE. Raspopov, O. M.; Koshelevskii, V. K. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 429-431(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 485-487(1972).

An investigation of all geophysical phenomena observed during the initial phase of auroral breakup and at instants of sharp increases in auroral activity indicates that these phenomena reproduce fairly well the picture of physical processes typical of the development of the pinch effect. (auth)

20686 EXCITATION OF MAGNETOSPHERIC RESONATORS. Van'yan, L. L.; Gokhberg, M. B. (Inst. of Space Research, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 435-440(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 492-497(1972).

An expression is obtained for magnetic-field variations at the surface of the Earth from a local source inside a resonator formed by the reflecting Earth–ionosphere systems of the northern and southern hemispheres. The expression for magnetic-field intensity is obtained for an arbitrary temporal variation of the source. (auth)

20687 DETERMINATION OF THE VELOCITY OF SHOCK WAVES IN THE INTERPLANETARY MEDIUM. Kuz'micheva, A. E.; Dorman, L. I.; Kaminer, N. S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 3, 472-473(1972).

Translated from Geomagn. Aeron.; 12: No. 3, 534-535(1972).

Computations made by Vernov, Lyubimov, Kontor, et al. (1971) of the velocity of shock waves recorded on March 23 and May 14, 1969 on Venera 6 and on the surface of the Earth are re-examined. The delay time of the events on Venera 6 and on the Earth with respect to chromospheric flares on the Sun was used to determine the average shock-wave velocity between the Sun and Venera 6 and between the latter and the Earth. The computations were performed on the assumption that the wave front was orthogonal to the Sun-detector line. Results show that allowance must be made for the fact that a spherical shock wave appears at a great distance from the Sun and is important when the difference in the solar coordinates of the chromospheric flare and the Earth is large. (JCW)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstract 20270.

20688 ENERGY SPECTRA OF NEUTRAL COMPONENTS IN SCATTERING BY A SOLID TARGET. Chicherov, V. M. JETP Lett. (USSR) (Engl. Transl.); 16: No. 6, 231-4(20 Sep 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 6, 328-31(20 Sep 1972).

Fast neutral atoms were stripped in a gas target and then energy analyzed in an electric field. The energy spectra of the ions and neutral atoms were obtained under identical conditions, making a comparison possible. A Cu target was bombarded by singly charged argon ions. The energy spectra of the ions on the (100) face of the Cu crystal and on a polycrystalline target was plotted in the absence of gas in the stripping chambers and with the guiding plates shorted. Spectra are also given for various gases in the stripping chamber. (MOW)

20689 METHOD FOR PRODUCING A BEAM OF POLARIZED ATOMS. Kaminsky, M. S. (to United States Atomic Energy Commission). U. S. Patent 3,700,899. 24 Oct 1972. Filed 26 Aug 1971.

A polarized beam of atoms is generated by forming a plurality of apertures of micron-sized diameter through a magnetically saturated monocrystalline material and passing in a partial vacuum a collimated beam of atoms through said apertures incident to the walls thereof. The monocrystalline material effects a charge-transfer reaction with the atomic beam to produce a polarized beam of atoms, the nuclei of which are subsequently polarized by hyperfine interaction in a weak external magnetic field. (auth)

20690 USE OF THE R-MATRIX METHOD IN ATOMIC CALCULATIONS. Robb, W. D. (Queen's Univ., Belfast). Comput. Phys. Commun.; 4: No. 1, 16-19(Oct 1972).

A brief account is given of the applicability of the R-matrix method to the calculation of e^--atom scattering cross sections, atomic polarizabilities and van der Waals coefficients, photoionization cross sections, nonlinear optical harmonic coefficients, Born ionization cross sections and free–free transition processes. The current state of the computer codes is discussed. (auth)

Atomic and Molecular Properties

Refer also to abstracts 21128 and 21169.

20691 THEORETICAL CONSIDERATION OF THE SOFT X-RAYS ABSORPTION BY THE 4d-ELECTRONS OF THE RARE EARTH IONS Er^{3+}, Tm^{3+}, AND Yb^{3+}. Glembotskii, I. I.; Karosene, A. V.; Kiselev, A. A.; (and others) (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 12: No. 1, 35-47 (1972). (In Russian).

The interpretation problem of the absorption spectra structure of the soft X-rays by the rare earth metals Er, Tm, and Yb has been considered. The energy operator matrices containing spin-orbit interaction have been calculated in LS-coupling scheme using the solutions of Hartree–Fock equations in one configuration approximation and diagonalized. The experimentally estimated structure of the spectra has been found as being due to the transitions $4d^{10}\,4f^n - 4d^9\,4f^{n+1}$ in threefold ions of the atoms under consideration. (auth)

20692 ISOTOPE SHIFTS IN THE 3.99-μm LASER TRANSITION OF XENON: GROWTH OF THE VOLUME EFFECT FOR (136, 134) AND (126, 124) COUPLES. Vetter, R. (CNRS, Orsay, France). Phys. Lett.; 42A: No. 3, 231-2(4 Dec 1972). (In French).

This letter gives the shifts between the isotopes 128, 126, and 124 in the 3.99 μm laser line of xenon. The constant value of the field effect between ^{134}Xe and ^{126}Xe is related to the regular variation of the nuclear deformation coefficients. (auth)

20693 ZERO-FIELD SPLITTINGS OF Gd^{3+} AND Cm^{3+} IN CeO_2 AND ThO_2. Kolbe, W.; Edelstein, N.; Finch, C. B.; Abraham, M. M. (Oak Ridge National Lab., TN). J. Chem. Phys.; 58: No. 2, 820-821(15 Jan 1973).

The $\Gamma_5 - \Gamma_6$ splitting of Cm^{3+} (the $5f^7$ actinide analog of Gd^{3+}) in CeO_2 is reported. By comparison with earlier data on Cm^{3+} and Gd^{3+} in other fluorite type hosts it is pointed out that the cubic splittings of the $5f^7$ ion, unlike the $4f^7$ case, do follow qualitatively the predictions of the point charge model. A list of the $\Gamma_8 - \Gamma_6$ splittings for Gd^{3+} and Cm^{3+} in various fluorite-type lattices is compiled. (JFP)

20694 J DEPENDENCE OF THE DEPOLARIZATION RATIO OF THE ROTATIONAL COMPONENTS OF THE Q BRANCH OF THE H_2 AND D_2 RAMAN BAND. Holzer, W. (CNRS, Paris); Le Duff, Y.; Altmann, K. J. Chem. Phys., 58: No. 2, 642-643 (15 Jan 1973).

The theory on rotational structure of Raman bands predicts—apart from the (2J + 1) magnetic degeneracy—an additional J dependence of anisotropic scattering. This implies a J dependence of the depolarization ratio, when measured for the separated rotational components $J \rightarrow J$ of the Q branch of Raman bands. We report here on experimental results obtained on the transitions J = 0, 1, ..., 4 of the Q branch of H_2 and D_2, which are in full agreement with theory. In particular we demonstrate the completely isotropic character of the 0–0 transition. Our experimental value for the depolarization ratio of the total vibrational Raman band of H_2 agrees well with the one obtained recently by ab initio calculations. (auth)

20695 LOW-ENERGY BREMSSTRAHLUNG CROSS SECTIONS. Heroy, D. B. Fort Worth, TX; Texas Christian Univ. (1972). 135p. University Microfilms Order No. 73-1581.

Thesis (Ph. D.).

Experimental bremsstrahlung cross sections differential in photon angle and photon energy have been obtained for incident electron energies of 50, 100, and 140 keV. Measurements have been made for thin targets of carbon, aluminum, copper, silver, and gold and for angles of 30, 45, 60, 90, and 135 degrees. Results were found to be in excellent agreement with previous experiments of Motz and Placious and Rester, et al., and with the theoretical calculations of Elwert and Haug and others for targets of aluminum and gold for 50 keV incident electrons. No other comparisons were possible. The work also investigates how bremsstrahlung cross sections depend on angle, energy, and atomic number.

20696 AB INITIO POTENTIAL SURFACE FOR H_4^+. Poshusta, R. D.; Zetik, D. F. (Washington State Univ., Pullman). J. Chem. Phys.; 58: No. 1, 118-125(1 Jan 1973).

A portion of the potential surface of H_4^+ was calculated with several wavefunctions based on valence bond configuration interaction. Polarization and ionized structures were considered. The calculated potential surface shows a long range attraction between H_2 and H_2^+ which becomes strong at short distances. Calculations were made on a potential hypersurface containing a favorable reaction coordinate for the reaction $H_2 + H_2^+ \rightarrow H_3^+ + H$. Simple wavefunctions without polarization show no long range attraction between H_3^+ and H; when polarization is included a long range attraction is found. Calculations with ionized structures and polarization suggest that H_4^+ is stable with a binding energy $D_0 = 0.85$ kcal/mole. Failure to detect H_4^+ is attributed to the absence of a mechanism to produce this ion under experimental conditions. (auth)

20697 APPLICATION OF THE RAYLEIGH–SCHROEDINGER PERTURBATION THEORY TO THE HYDROGEN ATOM. Aguilera Navarro, V. C.; Kloet, W. M.; Zimmerman, A. H. (Instituto de Fisica Teorica, Sao Paulo, Brazil). Rev. Brasil. Fis.; 1: No. 1, 55-61(Apr 1971).

The ground-state energy of a hydrogen atom is treated, according to Wigner, by the Rayleigh–Schrödinger perturbation method, where unperturbed wave functions correspond to a free particle in a spherical "box" of radius R. We have calculated the perturbed energy up to fifth order in e^2 and as the sign of each term from the second approximation on remains negative, we may conjecture that the perturbation series is divergent for $R \rightarrow \infty$. It also appears that in this way it will be difficult to obtain a Stieltjes series in the coupling constant e^2. We show that it is possible, by using the Rayleigh–Schrödinger-Löwdin variational energies, to obtain good values for the ground-state energy by adjusting conveniently the value of R. The Padé approximants give bad values for $R \rightarrow \infty$. (tr-auth)

20698 POTENTIAL ENERGY CURVE OF THE $B^1\Sigma_u^+$ STATE OF H_2. Stwalley, W. C. (Univ. of Iowa, Iowa City). J. Chem. Phys.; 58: No. 2, 536-540(15 Jan 1973).

The serious disagreement between ab initio and Rydberg–Klein–Rees potential energy curves for the $B\ ^1\Sigma_u^+$ state of H_2 is discussed and explanations suggested. A "best available" hybrid potential energy curve for the $B^1\Sigma_u^+$ state is then proposed. (auth)

20699 FINE AND HYPERFINE STRUCTURE OF THE 2p AND 3p $^3\Pi_u$ STATES OF H_2. Lombardi, M. (Domaine Univ., Grenoble, France). J. Chem. Phys.; 58: No. 2, 797-802(15 Jan 1973).

One- and two-electron fine and hyperfine structure constants of the 2p and 3p $^3\Pi_u$ levels of the hydrogen molecule have been calculated using the 45-50-configuration elliptic coordinates wavefunctions of Rothenberg and Davidson. The two-electron integrals have been reduced to electron repulsion integrals. The resulting constants agree within 1 to 5% with experiment. (auth)

20700 BOUNDS FOR ENERGIES OF RADIAL LITHIUM. Fox, D. W.; Sigillito, V. G. (Johns Hopkins Univ., Silver Spring, MD). Z. Angew. Math. Phys.; 23: No. 3, 392-411(1972).

The first application of a new method is presented for lower bounds to eigenvalues of operators of the kind that describe the energies of atoms and ions. We consider radial models of these atoms and carry out a detailed analysis for radial lithium. The calculations yield the required displacement of essential spectra and give lower bounds where all other methods fail. (auth)

20701 ROTATIONAL–VIBRATIONAL DIPOLE TRANSITIONS IN HD. Wolniewicz, L.; Kowalski, T. (Inst. of Physics, Torun, Poland). Chem. Phys. Lett.; 18: No. 1, 55-58(1 Jan 1973).

The transition moments are computed for several lines in the $X\ ^1\Sigma_g^+$ state of HD. The results are obtained by taking into account interactions with Σ_u and Π_u states. It is shown that the latter influence appreciably the transition probabilities in the 0–0 band. The permanent dipole moment is also computed for several vibrational and rotational states. (auth)

20702 MULTI-CONFIGURATION HARTREE–FOCK PROGRAM WITH IMPROVED STABILITY. Froese Fischer, C. (Univ. of Waterloo, Ont.). Comput. Phys. Commun.; 4: No. 1, 107-116(Oct 1972).

Numerical nonrelativistic Hartree–Fock results are determined within the multi-configuration approximation for atoms in a bound state. The self-consistent field method of solution is employed. In a multi-configuration calculation the mixing coefficients are adjusted periodically as part of the SCF iteration. Two new methods are used for the solution of the differential equations. (WDM)

20703 PROGRAM FOR COMPUTING LEVEL CROSSINGS AND THE BACK-GOUDSMIT EFFECT. Violino, P. (Univ., Pisa, Italy). Comput. Phys. Commun.; 4: No. 1, 128-137(Oct 1972).

Several techniques of atomic spectroscopy, like hfs measurements, level crossings, Hanle effect (when the hfs is of the order of the width of a level), all require a precise knowledge of the positions of the sublevels of a fine or hyperfine multiplet as functions of the applied magnetic field. When the quantum numbers I and J are larger than $\frac{1}{2}$, this requires the solution of the secular equation. This is carried out by this computer program, which can compute as well the positions of the level crossings between specified levels. The solution is carried out by computing the secular matrix from the input data and then diagonalizing it. The positions of the level crossings are computed by an iterative procedure. (WDM)

20704 PROTON-REDUCED L X-RAY SPECTRUM OF ARGON. Der, R. C.; Fortner, R. J.; Kavanagh, T. M. (Univ. of California, Livermore). Phys. Lett.; 42A: No. 5, 337-338(1 Jan 1973).

The argon L X-ray spectrum produced by 100 keV protons is presented. A new line, not observed in the electron-produced spectrum, appears at 262 eV is interpreted as a $3d \rightarrow 2p$ transition. Since the 3d level is normally empty in argon, the data provide the first direct evidence from X-rays following proton bombardment of excitation of electrons to bound states. (auth)

20705 DATA ANALYSIS METHODS IN THE TIME CORRELATION MEAN LIFETIME MEASUREMENTS. Dumont, A. M.; Camhy-Val, C. (CNRS, Meudon, France). Nucl. Instrum. Methods; 106: No. 3, 413-417(1973).

Various data analysis methods have been successively tested in mean lifetime measurements by delayed coincidences or time correlation. The method which leads to the minimum statistical error, when the signal-to-noise ratio is small and the random correlations are important, uses a Fourier Transform technique. (auth)

20706 INTERPRETATION OF THE COTTON EFFECT IN CRYSTALLINE SODIUM URANYL ACETATE. Vysin, V.; Janku, V. (Palacky Univ., Olomouc, Czech.). Opt. Commun.; 7: No. 1, 36-37(Jan 1973).

The experimental data for circular dichroism of sodium uranyl acetate are fit with a theoretical expression containing two terms. (auth)

20707 PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON ATOMIC, MOLECULAR, AND SOLID-STATE THEORY AND QUANTUM BIOLOGY, HELD AT SANIBEL ISLAND, FLORIDA, JANUARY 17–22, 1972. Loewdin, Per-olov (ed.). Int. J. Quant. Chem., Symp.; No. 6, 1-465(1972). (CONF-720127).

Separate abstracts were prepared for nine of the papers in this volume. The remaining forty-five are not included in the subject scope of NSA. (RWR)

For abstracts of individual papers see: 20708–20712, 20715, 20742, 20743, and 21548.

20708 RELATIVISTIC TREATMENT OF OUTER ELECTRON ORBITALS. Desclaux, J. P. (Northwestern Univ., Evanston, IL). Int. J. Quant. Chem., Symp.; No. 6, 25-41(1972).

From International Symposium on Atomic, Molecular and Solid-State Theory and Quantum Biology; Sanibel Island, Florida, United States of America (USA) (17 Jan 1972).

See CONF-720127-.

Recent advances in the methods for computing relativistic Hartree–Fock wave functions have led to a revival of interest in investigating relativistic effects in atoms. While many papers have been related to topics in which these effects are obviously important, such as K-shell ionization energies for heavy elements, superheavy elements, etc., less attention has been spent on the indirect relativistic effects and on the comparison of the relative importance of correlation and relativistic effects. These latter two points are illustrated by a small number of examples, drawn from various fields, such as hyperfine interaction, optical spectra, and oscillator strengths. This review of recent applications of relativistic calculations shows the importance of relativistic effects to improve the agreement between ab initio calculations and experimental results. (auth)

20709 SIMPLE NON-EXPONENTIAL FUNCTION FOR USE IN ATOMIC AND MOLECULAR WAVE FUNCTIONS. Scherr, C. W. (Univ. of Texas, Austin). Int. J. Quant. Chem., Symp.; No. 6, 51-58(1972).

From International Symposium on Atomic, Molecular and Solid-State Theory and Quantum Biology; Sanibel Island, Florida, United States of America (USA) (17 Jan 1972).

See CONF-720127-.

The function $\phi_m(r,\mu) = (1 + \mu r/m)^{-m}$, previously discussed in connection with the helium atom isoelectronic series, is applied in more extended calculations to the same systems and to the hydrogen molecule in their ground states. Expectation values of various powers of r_1 and r_{12} are calculated. It is concluded that the $\phi_m(r,\mu)$ are convenient to use and, in particular, show promise of being useful in the study of negative ions. (10 tables) (auth)

20710 THEORY OF AUTOIONIZATION LIFETIMES. Nazaroff, G. V. (Michigan State Univ., East Lansing). Int. J. Quant. Chem., Symp.; No. 6, 87-102(1972).

From International Symposium on Atomic, Molecular and Solid-State Theory and Quantum Biology; Sanibel Island, Florida, United States of America (USA) (17 Jan 1972).

See CONF-720127-.

A configuration-interaction method is presented for calculating autoionization lifetimes. The problem is separated into a bound-state part and a scattering part, and each part is carried out separately. The bound-state part of the calculation is a straightforward matrix diagonalization over a discrete basis set. The scattering calculation involves a simple Kohn variational procedure. Most of the work is put into the bound-state part of the calculation, and it is this part of the problem that contains most of the information about the interactions occurring in the system. The role of the scattering function is to insure the proper asymptotic form, and for this reason a simple scattering function is sufficient. The method is generally applicable to many-electron systems and makes maximal use of the techniques developed for bound states. The method is compared with the close-coupling, the stabilization, and the Fano configuration-interaction techniques and is shown to combine the strong points of each of them. (3 tables) (auth)

20711 RESULTS OF AN ANALYTIC CALCULATION FOR THE COHERENT ATOMIC SCATTERING FACTOR FOR THE GROUND STATE OF THE HELIUM ISOELECTRONIC SEQUENCE. Sahni, V. (Polytechnic Inst. of Brooklyn); Krieger, J. B. Int. J. Quant. Chem., Symp.; No. 6, 103-109(1972).

From International Symposium on Atomic, Molecular and Solid-State Theory and Quantum Biology; Sanibel Island, Florida, United States of America (USA) (17 Jan 1972).

See CONF-720127-.

The analytical method developed by the authors for the determi-

nation of the expectation value of single-particle operators $W = \Sigma_i W(r_i)$ correct to second order is employed to obtain an analytic expression for the coherent atomic scattering factor, F(k), for the ground state of the helium isoelectronic sequence valid for all values of momentum transfer. The trial wave function, ψ_{OT} employed is an energy-minimized Hartree product of hydrogenic states. For helium the results for the form factor are within 1.2% of the highly accurate values calculated using 120-parameter configuration-interaction wave function, and have an accuracy equivalent to that of an analytical Hartree–Fock treatment. This error is further reduced as the atomic number is increased. The calculations are extended to the infinite-momentum-transfer range, and the accuracy of the results are studied in this limit by employing the Kato electron–nucleus cusp condition for the exact ground-state wave function of two-electron atomic systems. In the infinite-momentum-transfer limit the results for helium are in error by 0.57%, and this error is further diminished for each successive element of the isoelectronic sequence. In addition, the cusp condition is exactly satisfied and is independent of the variational parameter employed in the trial wave function. (auth)

20712 ANALYTIC GROUND STATE ENERGIES OF TWO-ELECTRON ATOMS. Callan, E. J. (Aerospace Research Labs., Wright-Patterson Air Force Base, OH). Int. J. Quant. Chem., Symp.; No. 6, 431-434(1972).

From International Symposium on Atomic, Molecular and Solid-State Theory and Quantum Biology; Sanibel Island, Florida, United States of America (USA) (17 Jan 1972).

See CONF-720127-.

A simple product wave function is used, but the interelectronic repulsion term in the Hamiltonian is modified to the form $1/r_{12}$ only to a closest approach distance; a constant potential is assumed within this distance. Results for calculations of the ground-state energies of two-electron atoms are tabulated. It is concluded that simple hydrogenic functions can be extended if the inner truncated Coulomb potential is used for interelectronic repulsion. (1 table) (RWR)

20713 EFFECT OF ROTATION ON THE COMPUTED THERMAL DISSOCIATION RATE OF H_2. Dove, J. E.; Jones, D. G. (Univ. of Toronto). Chem. Phys. Lett.; 17: No. 1, 134-136(1 Nov 1972).

In thermal dissociation rate of H_2 dilute in argon between 1500 and 15,000°K has been calculated using the model of a rotating anharmonic oscillator for the diatomic molecule. The coupled differential equations which govern the populations of all the vibration–rotation levels of para H_2 have been solved numerically. The results show that the inclusion of the effects of rotation in the calculations greatly increases the dissociation rate and lowers the computed Arrhenius activation energy to give substantial agreement with experimental measurements in normal H_2. (auth)

20714 MULTIPOLE EXPANSION OF THE RETARDED INTERATOMIC POTENTIAL ENERGY: DERIVATION FROM RELATIVISTIC ELECTRON THEORY. Michels, M. A. J.; Suttorp, L. G. (Univ., Amsterdam). Phys. Lett., A; 42A: No. 7, 473-474(29 Jan 1973).

The inductive and dispersive retarded interaction energies of two ground state hydrogen atoms described by Dirac theory are obtained up to all multipole orders. The long range terms are given as symmetric expressions in the electric and magnetic dipole moments. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 19913, 20707, and 20900.

20715 WHAT CAN ONE LEARN WITH MUONS ABOUT ATOMIC PHYSICS? Fricke, B. (Northwestern Univ., Evanston, IL). Int. J. Quant. Chem., Symp.; No. 6, 43-46(1972).

From International Symposium on Atomic, Molecular and Solid-State Theory and Quantum Biology; Sanibel Island, Florida, United States of America (USA) (17 Jan 1972).

See CONF-720127-.

It is possible to study the "true" interaction between two charged particles more precisely with muonic atoms than with the usual electronic atoms. This knowledge, together with Dirac–Fock calculations, enables calculation of the precise binding energies of electrons for very heavy elements, which leads to a prediction of x-ray spectra, which can be used to identify superheavy elements. With muonic atoms hydrogenic atomic orbitals can be studied for all possible nuclei; in addition, since the muon is so near the nucleus, all effects depending on the distance from the nucleus are much more significant than in electron atoms. Polarization charge and polarization charge density can be most effectively studied in high muonic transitions, as can the electron shielding effect. Muonic γ-ray spectra can be used to determine the electronic charge distribution inside a radius of about 0.3 Å. (2 tables) (RWR)

Collision Phenomena

Refer also to abstracts 19587, 20704, 20707, 20840, and 21465.

20716 (IPPJ-129) IONIZATION OF ENERGETIC NEUTRAL ATOMS ON A METALLIC SURFACE. Honzawa, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1972. 11p.

Experimental study is described on the ionization of energetic neutral atoms on an untreated, metallic surface. The energy loss associated with the ionization is found to depend strongly on the incident angle of the particles onto the surface. The efficiency of ionization is of the order of 10^{-6}. Angular distribution of the ions leaving the surface is also measured. (auth)

20717 (N-72-28715) CURVE CROSSING FOR LOW-ENERGY ELASTIC SCATTERING OF He^+ BY Ne. Bobbio, S. M.; Doverspike, L. D.; Champion, R. L. (College of William and Mary, Williamsburg, VA. Dept. of Physics). 1972. 20p. (NASA-CR-127461). NTIS.

The perturbation seen in the experimental differential elastic scattering cross section for the 40 eV He(+) + Ne system was attributed to a single crossing of two intermolecular potential energy curves. A new theoretical treatment of the curve crossing problem, that of Delos and Thorson, is employed to obtain the crossing probabilities and phases associated with the crossing. These are determined by utilizing ab initio potentials involved in the crossing and are further used in a partial wave calculation of the cross section, which is compared with our experiment. The origin of the oscillatory structure observed in the differential cross section is discussed in semiclassical terms by defining the problem in terms of two pseudo-deflection functions. A rainbow effect is shown to be related to a particular feature (a maximum rather than a minimum) of these deflection functions. (INIS)

20718 (N-72-28716) EXCITATION OF VACUUM ULTRAVIOLET RADIATION BY ELECTRON IMPACT ON CARBON MONOXIDE: SOME UNRESOLVED QUESTIONS NEAR THRESHOLD. Wells, W. C.; Zipf, E. C. (Pittsburgh Univ., Pa. Space Research Coordination Center). Jun 1972. Contract DA-31-124-ARO(D)-440. 7p. (NASA-CR-172692). NTIS.

The threshold behavior of the ultraviolet photon excitation function for electron impact on carbon monoxide was studied for the pseudo-resonance signal reported elsewhere. Time of flight spectrometer techniques were not able to confirm the resonant feature in excited CO states under electron impact. (auth)

20719 (ORNL-4811, pp 25-34) ELECTRON AND ION COLLISION PHYSICS. Compton, R. N.; Anderson, V. E.; Carter, Ada; (and others). Sep 1972.

In Health Physics Division annual progress report for period ending July 31, 1972.

The discussion of electron and ion collision covers metastable anions of CO_2, ionization phenomena in several metallocenes, electron attachment to organic molecules, chemi-ionizing collisions, ion condensation reactions in benzene vapor, determination of electron affinities in collisional ionization of cesium by molecules, longitudinal electron diffusion coefficient and electron drift velocity in water vapor, thermal and near-thermal electron transport coefficients in O_2, and chlorine gas evolution from irradiated rock salt. (JFP)

20720 (UCSD-34-P-196-18) THEORETICAL STUDY OF ENERGY-TRANSFER PROCESSES. Annual Progress Report, November 1, 1971–October 31, 1972. Chen, J. C. Y. (California Univ., La Jolla, San Diego). 17 Jul 1972. Contract AT(04-3)-34. 8p. Dep. NTIS.

Research is summarized on energy-transfer processes following the interaction of ionization radiation with gaseous and condensed media. Electron interactions with atoms and molecules, photoionization and recombination processes and ion–molecule interactions are emphasized. The experimental results are interpreted and analyzed, and information on energy-transfer processes under conditions not directly accessible to experimental measurements is obtained. (JFP)

20721 DETAILED BALANCING IN THE TIME-DEPENDENT IMPACT PARAMETER METHOD. Gerjuoy, E. (Univ. of Pittsburgh). Case Stud. At. Phys.; 3: No. 1, 1-45(Jul 1972).

For collisions of the form a + b → c + d, it is shown that detailed balance will be formally satisfied in the impact parameter coupled state approximation (as it is commonly employed in atomic collisions), and will have a believable physical interpretation, provided the coupled state expansion functions are properly chosen. The connections between microreversibility relations in the coupled state approximation, in the impact parameter method without the coupled state approximation, and in the original pre-impact-parameter description of the collision by a time-independent Hamiltonian, are elucidated. The discussion is valid for systems composed of spinless and/or spin ½ particles, distinguishable or indistinguishable, and takes into account the transformation properties of the spin functions under the time-reversal and reflection operations relevant to microreversibility in the impact parameter method; straight line constant speed motion of a relative to b is not assumed. The relation—of the present more general treatment—to a proof of detailed balancing in the coupled state approximation previously given by Green, but valid only for spinless particles and relatively simply transforming expansion functions is clarified. (auth)

20722 CALCULATIONS ON ENERGY TRANSFER TO A DIATOMIC MOLECULE IN HIGH-ENERGY HEAD-ON COLLISIONS. Van Dop, H.; Boerboom, A. J. H.; Los, J. (FOM-Instituut voor Atoom- en Molecuulfysica, Amsterdam). Physica; 61: No. 4, 616-625(15 Oct 1972).

In collisions where the incident particle has zero impact parameter with respect to one of the atoms of the molecule the energy transfer and the scattering angle are calculated as functions of energy and molecular orientation. The interaction between the atoms of the molecule and the incident particle is described by an exponential potential. Three intramolecular potentials are used: a harmonic, a Morse, and a modified Buckingham potential. No important differences are found in the results of the application of the last two potentials. At low energies the energy-transfer data and (laboratory) small-angle scattering data show that the molecule, in its totality, is involved in the collision. When the energy is increased only one atom of the molecule is involved in the collision, while the other is "watching" the collision. These so-called "stripping" or "spectator" collisions reveal, as it were, the mass structure of the molecule. Finally some experimental data are discussed in connection with this collision model. (auth)

20723 ELASTIC SCATTERING OF K^+ IONS FROM DIATOMIC MOLECULES IN THE ENERGY RANGE FROM 150 TO 4000 eV. Van Dop, H.; Boerboom, A. J. H.; Los, J. (FOM-Instituut voor Atoom- en Molecuulfysica, Amsterdam). Physica; 61: No. 4, 626-629(15 Oct 1972).

Potential parameters are determined for the combinations K^+–H_2, HD, D_2, N_2, $C^{16}O$ and $C^{18}O$. The best description for the interaction is given by an exponential potential. The (small) differences in cross section between the iso-electronic molecules are within the experimental error. A correlation, however, is observed between the asymmetry of the molecules and the measured cross sections. (auth)

20724 MOLECULAR BEAM DETERMINATION OF ALKALI ION–RARE GAS POTENTIALS. Powers, T. R.; Cross, R. J. Jr. (Yale Univ., New Haven). J. Chem. Phys.; 58: No. 2, 626-633 (15 Jan 1973).

Scattering cross sections have been measured for K^+ and Na^+ on He, Ne, Ar, Kr, and Xe over the LAB energy range of 40 to 1000 eV. The data have been analyzed to give intermolecular potentials for these systems in the range of thermal energies to ~0.2 eV. The He and Ne systems could be fit with a purely repulsive wall. For the heavier rare gases the strong attractive ion-induced-dipole force contributed measurably in our energy range. The potentials are harder than the corresponding neutral alkali systems with well depths roughly ten times as large. (auth)

20725 STOPPING CROSS SECTION CALCULATIONS FOR HELIUM ON VARIOUS ELEMENTS. Harberger, J. H. Charlottesville, VA; Univ. of Virginia (1972). 142p. University Microfilms Order No. 72-33,363.

Thesis (Ph.D).

The binary-encounter theory is used to calculate electronic stopping cross sections of a large number of atoms for helium. The model describing the stopping process assumes that the target electrons are free and that they have a velocity distribution obtained from the Fourier transforms of appropriate Hartree–Fock wave functions. The stopping cross section as a function of target electron velocity, which is obtained by counting all collisions in which the target electron gains an energy greater than the first excitation energy of its shell, is averaged over the velocity distribution of the target electrons to obtain the total stopping cross section for the atom in question. The distribution of charge state components in the incident beam is considered explicitly. First, stopping cross sections for each component are determined separately in the manner described above, and then, the results are combined using estimates for the equilibrium charge state fractions obtained from the best available experimental data. The calculated results are compared with experimental data and with other theoretical results both as a function of incident particle energy and as a function of target z. (Diss. Abstr. Int., B)

20726 ELECTRON TRANSMISSION SPECTROSCOPY: RARE GASES AND DIATOMIC MOLECULES. Sanche, L. New Haven; Yale Univ. (1972). 123p. University Microfilms Order No. 73-7.

Thesis (Ph.D).

A transmission experiment is used to observe the structure in the total electron-impact cross section in the rare gases and in diatomic molecules. The structure in the cross sections is enhanced by measuring directly the derivative of the transmitted current. New resonances are observed in the total scattering cross section for He, Ne, Ar, Kr and Xe below the respective ionization potentials, and also in the region of autoionizing states. The positions of the resonances are tabulated and compared with the results of other investigators. In both neon and argon, relatively large, isolated, resonances exist near the edge of the Rydberg series involving inner-shell autoionizing states, i.e., near 47.5 and 29 eV respectively. Many new resonances are also reported in the total scattering cross section of H_2, D_2, O_2, NO, N_2 and CO. In all these gases we find bands which consist of progressions of negative ion vibronic states. The existence of bands makes the identification of the temporary negative ion states easier since the spacing and the magnitudes of the structure can be compared with the appropriate parameters of various positive ion cores. The most prominent features observed consist of two Rydberg electrons attached to a particular positive ion core. (Diss. Abstr. Int., B)

20727 DIFFERENTIAL SCATTERING OF He^{++} FROM RARE GASES. Chen, Y. H. Charlottesville, VA; Univ. of Virginia (1972). 103p. University Microfilms Order No. 72 33,354.

Thesis (Ph.D).

The principal processes (elastic scattering, excitation, and single-electron capture) in collisions between He^{++} and He, Ne and Ar are studied experimentally in the angular range 0 to 25 degrees for incident He^{++} energies 200 to 600 eV. At each observed scattering angle, kinetic energies of scattered ions are analyzed by an electrostatic analyzer to distinguish different processes and then detected by a channel electron multiplier whose output pulses are counted individually. The results are examined to identify, where possible, the single-electron capture exit channels. Information from the angular and energy distributions of the scattered ions is used to calculate the absolute differential scattering cross section as a function of the scattering angle, the incident energy, and the energy defect. Scattering leading to direct excitation of the target atoms is negligible compared to the elastic scattering and single-electron capture. For each of the three systems studied, no electron capture leading to ground-state product ions is observed, i.e., their cross section is below the 10^{-20} cm^2 detection limit of our apparatus. In our range of angle and energy the elastic scattering cross sections all display a rapid fall-off from those obtained from an exponentially screened Coulomb potential. A pronounced oscillatory structure, characteristic of resonant charge exchange in symmetric systems, is observed in the elastic scattering cross sections for the system He^{++}-He. In He^{++}-Ne collisions, probable selection rules are obtained for the single-electron capture exit channels. (Diss. Abstr. Int., B)

20728 TOPICS ON LONG-RANGE ATOMIC INTERACTIONS. Alvarez Rizzatti, M. Providence; Brown Univ. (1972). 146p. University Microfilms Order No. 73-2223.

Thesis (Ph.D).

In the first part the charge-transfer energy is calculated for alkali ion-rare-gas atom systems and for alkaline-earth-helium atom systems. Accurate calculations are discussed for the two systems H^+He and Li^+He. For the remaining systems approximate models are used which ignore the core electrons by proper use of screening constants. The charge-transfer energy is found to be of comparable magnitude to the induction energy over a range of separations close to and larger than the separation for which the total potential energy has a minimum. Accordingly, it is expected that for alkali ion-rare-gas atom systems the 12-6-4 model, which ignores the charge-transfer energy, underestimates the potential energy. It is suggested that a model is needed to estimate the total potential energy more generally. In the second part, the calculation of dipole-quadrupole dispersion coefficients is discussed. Two schemes are suggested,

one in the perturbation method and one in the variational method. Values are calculated for the interaction of atomic pairs by any of the alkali atoms and the rare-gases (except krypton and xenon). (Diss. Abstr., Int., B)

20729 CALCULATIONS OF IONIZATION BY HEAVY IONS STOPPED IN A GAS. Miller, M. S. Charlottesville, VA; Univ. of Virginia (1972). 79p. University Microfilms Order No. 72-33, 375.

Thesis (Ph.D).

Calculations are made of the total inelastic energy loss suffered by a fast ion or atom that is slowed in a gas. The electronic energy losses resulting from a single collision are treated according to the theories of Lindhard and Firsov. Energy losses associated with the nuclear motion are treated as classical elastic scattering, and the sensitivity of the calculation to the assumed interaction potential is demonstrated. Previous calculations have employed only Thomas-Fermi and power law potentials and a perturbation approximation to the deflection function developed by Lindhard, et al. A check on this approximation by the more accurate method of Gauss–Mahler quadratures indicates that the reasonable accuracy obtained for the Thomas–Fermi potential is sacrificed for more rapidly varying potentials. Using the more accurate deflection function, calculations for several potentials are made and compared to data derived from experimental ionization measurements under the assumption that the relative proportions of ionization and excitation remain the same at all projectile energies. (Diss. Abstr. Int., B)

20730 SEMICLASSICAL THEORY OF REARRANGEMENT AND EXCHANGE COLLISIONS. Eu, B. C. (McGill Univ., Montreal). J. Chem. Phys.; 58: No. 2, 472-478(15 Jan 1973).

A semiclassical theory of rearrangement and exchange collision processes is developed as an extension of the semiclassical theory of inelastic collisions reported in the earlier papers in this series. The uniform WKB solutions are again used to obtain the WKB solutions of a set of integrodifferential equations that describe the relative motions of the collision fragments in various channels. The solutions obtained are free of the turning point difficulty characteristic of the usual WKB solutions and thus most suitable for various calculations. The S matrix is constructed from the WKB solutions and given in terms of quadratures involving Airy functions. Approximation of the S matrix thus constructed is also discussed along with a discussion on a possibility of exploiting curve crossings. (auth)

20731 VELOCITY DEPENDENCE OF ELECTRONIC TO VIBRONIC ENERGY CONVERSION FOR $Hg(6^3P_2)$ IN MOLECULAR COLLISIONS. Krause, H. F.; Datz, S.; Johnson, S. G. (Oak Ridge National Lab., TN). J. Chem. Phys.; 58: No. 1, 367-373 (1 Jan 1973).

The de-excitation of metastable mercury atoms ($6^3P_2 \rightarrow 6^3P_1$) by collisions with H_2, D_2, N_2, NO, and CH_4 has been studied in a modulated crossed beam experiment. The molecular beam was velocity selected, and the photon emission at 2537 A was studied vs the molecule speed. From these measurements, quenching cross sections vs initial collision energy are derived. These results, which are discussed in terms of two existing theories, suggest that quenching occurs when electronic-vibrational terms of the quasimolecule intersect. (auth)

20732 THEORETICAL ASPECTS OF SECONDARY ELECTRON EMISSION FROM CU PRODUCED BY BOMBARDMENT WITH LOW ENERGY ELECTRONS. Cailler, M.; Ganachaud, J. P. (Ecole Nationale Superieure de Mecanique, Nantes, France). J. Phys. (Paris); 33: No. 10, 903-913(Oct 1972). (In French).

Secondary electron emission from thick polycrystalline metallic targets subjected to electron bombardment is studied from the theoretical point of view for a primary beam energy of 200 eV. This analysis distinguishes between the following processes: creation, transport, and the crossing of the metal-vacuum interface by the excited electrons. Cu was chosen to test the various different hypothesis. A preliminary treatment takes into account the different processes using a Boltzmann equation. When the maximum penetration depth of the primary electrons cannot be considered large in comparison with the mean free path of the excited electrons a Monte Carlo simulation method is used. The results obtained by the two methods are very similar. In general the agreement with experiment is good. (France)

20733 NONADDITIVE POLARIZABILITY OF A SYSTEM OF INTERACTING ATOMS. Balmakov, M. D.; Tulub, A. V. Opt. Spectrosc. (USSR) (Engl. Transl.); 32: No. 5, 462-464(May 1972).

Translated from Opt. Spektrosk.; 32: No. 5, 871-874(May 1972).

An expression was obtained for the anisotropy of the polarizability tensor of a system consisting of two atoms whose interaction was taken into account in the approximation of dipole–dipole and dipole–quadrupole interactions. Numerical calculations were carried out for the case of two hydrogen atoms. An expression was obtained giving the principal term of the anisotropy of the polarizability tensor for any atoms. (auth)

20734 MEASUREMENTS OF DIFFERENTIAL CROSS SECTIONS FOR VIBRATIONAL QUANTUM TRANSITIONS IN SCATTERING OF Li^+ ON H_2. David, R.; Faubel, M.; Toennies, J. P. (Max Planck-Institut fuer Stroemungsforschung, Goettingen, Ger.). Chem. Phys. Lett.; 18: No. 1, 87-90(1 Jan 1973).

A pulsed monoenergetic $^7Li^+$ ion beam (lab. energy 10 to 40 eV) is scattered from a highly collimated (±1.5°) H_2 nozzle beam. The time-of-flight spectrum of the ions scattered in the forward laboratory direction shows both a fast peak corresponding to forward center-of-mass scattering and a slow peak corresponding to wide-angle center-of-mass scattering. These peaks have been further resolved to show contributions from individual vibrational quantum transitions. From an analysis of the time-of-flight spectra the differential inelastic cross sections for a wide range of angles and energies between 2 eV < E_{cm} < 9 eV have been determined. The spectra also contain information on rotational inelastic cross sections. (auth)

20735 FORMATION OF PROTONS BY IMPACT OF LOW-ENERGY ELECTRONS ON WATER MOLECULES. Appell, J.; Durup, J. (Paris Univ., Orsay, France). J. Mass Spectrom. Ion Phys.; 10: No. 3, 247-65(Jan 1973).

The formation of H^+ and D^+ upon 18 to 40 eV electron impact on H_2O and D_2O is studied. The evolution of the appearance potential of H^+ (D^+) with its initial translational energy provides information on the formation processes of this ion. Evidence is given that the main process in this energy range is the pre-dissociation of the ionic molecular state formed by removal of one innermost valence electron ($1b_2$); five other processes are observed and discussed. (auth)

20736 INVERSE CONVOLUTION APPLIED TO THE EVALUATION OF ELECTRON-IMPACT IONIZATION-EFFICIENCY CURVES. Vogt, J.; Pascual, C. (Univ., Basel). J. Mass Spectrom. Ion Phys.; 9: No. 5, 441-8(Oct 1972).

The most accurate method of evaluating ionization efficiency curves is deconvolution by means of Fourier transforms. This normally requires the use of digital computers. A procedure is proposed which, on the assumption of a Maxwell energy distribution of the electrons, exactly corresponds to the above mentioned deconvolution without necessitating, however, the use of Fourier transforms. (auth)

20737 KINETIC ENERGY OF COLLISIONAL DISSOCIATION PRODUCTS OF 40-KeV CH_n^+ IONS. I. DISSOCIATION OF CH_3^+, CH_4^+, CH_5^+, AND CH_2^+ IONS. Roussel, M.; Julienne, A. (CEN, Fontenay-aux-Roses, France). J. Mass Spectrom. Ion Phys.; 9: No. 5, 449-62(Oct 1972). (In French).

The kinetic energy of fragments and especially of H^+, H_2^+, H_3^+ ions obtained from collisional dissociation of 40 keV CH_3^+, CH_4^+, CH_5^+, CH_2^+ ions has been measured by electrostatic analysis. These measurements, which are complementary to those obtained by electron impact on hydrocarbons, make it possible to propose dissociation mechanisms and to estimate the energy of the excited complexes. (auth)

20738 KINETIC ENERGY OF COLLISIONAL DISSOCIATION PRODUCTS OF 40-keV CH_n^+ IONS. II. DISSOCIATION OF CH^+. Roussel, M.; Julienne, A. (CEN, Fontenay-aux-Roses, France). J. Mass Spectrom. Ion Phys.; 9: No. 5, 463-70(Oct 1972). (In French).

The kinetic energy of protons and hydrogen atoms arising from collisional dissociation of 40 keV CH^+ ions has been measured by electrostatic analysis, after reionization of the neutrals. The distribution of the kinetic energy released by the dissociation $CH^+ \rightarrow C^+ + H$, which has maxima at 0.3 and 2.9 eV, is similar to that determined by another method and consistent with suppositions based upon the analysis of potential energy curves of CH^+ and of the lifetime of some transitions. The distribution of the kinetic energy released by the dissociations $CH^+ \rightarrow C + H^+$ and $CH^+ \rightarrow C^+ + H^+ + e$, which has never been studied, exhibits maxima at 0.7, 1.2, 2.9, 5.7 and 8.4 eV, which are also consistent with the suppositions. (auth)

20739 EFFECTIVE CROSS SECTIONS AND EXCITATION FUNCTIONS OF SPECTRAL BANDS OF THE CO_2^+ ion EXCITED BY 0.4- TO 20-keV ELECTRONS. Koval, A. G.; Koppe, V. T.; Danilevskii, N. P.; Popova, L. I. Opt. Spectros. (USSR) (Engl. Transl.); 32: No. 5, 559-560(May 1972).

Translated from Opt. Spektrosk.; 32: No. 5, 1037-1038(May 1972).

The effective excitation cross sections of nine bands of the Fox–Duffendack–Barker system of CO_2^+ arising from the transitions $2\pi_u - 2\pi_g$ and $2\pi_g - 2\pi_g$ were measured. Values are given for the effective excitation cross sections of the measured bands. (JFP)

20740 EXCITATION OF NITRIC OXIDE MOLECULE BY SLOW ELECTRONS. Povch, M. M.; Skubenich, V. V.; Zapesochnyi, I. P. Opt. Spectrosc. (USSR) (Engl. Transl.); 32: No. 5, 565 (May 1972).

Translated from Opt. Spektrosk.; 32: No. 5, 1044-1045 (May 1972).

The shape of the optical excitation functions of the spectral bands of the beta and gamma systems of the NO molecule was measured for excitation by 10 to 300 eV electrons. The excitation probability and fine structure are discussed. (JFP)

20741 SOME ASPECTS OF EXCITATION FUNCTIONS OF LITHIUM AND SODIUM ATOMS BEYOND THE IONIZATION THRESHOLD. Aleksakhin, I. S.; Bogachev, G. G.; Postoi, E. N. Opt. Spectrosc. (USSR) (Engl. Transl.); 32: No. 5, 566-567 (May 1972).

Translated from Opt. Spektrosk.; 32: No. 5, 1045-1047 (May 1972).

Experimental data on the excitation of the s electron of lithium and sodium atoms in the range between the first and second ionization potentials is presented. The method of intersecting beams was used. Excitation functions of spectral lines corresponding to certain transitions in sodium and lithium were obtained. The nature of the origin of secondary maxima is discussed. (JFP)

20742 CALCULATIONAL PROCEDURE FOR ELECTRON–ATOM SCATTERING AT ARBITRARY ENERGIES. Callaway, J.; Matese, J. J. (Louisiana State Univ., Baton Rouge). Int. J. Quant. Chem., Symp.; No. 6, 79-85 (1972).

From International Symposium on Atomic, Molecular, and Solid-State Theory and Quantum Biology; Sanibel Island, Florida (17 Jan 1972). See CONF-720127.

The close-coupling method for electron–atom scattering is generalized and extended with the aid of the Nesbet variational method to provide a general procedure for the calculation of any transition. These features are introduced. An arbitrary set of basis states is used for the atom (pseudostates), containing components in the continuum, which becomes complete if extended indefinitely. The pseudo channels introduced above are allowed to be open. The T matrix (rather than the R matrix) is calculated directly. (auth)

20743 COUPLED-CHANNEL INVESTIGATION OF ROTATIONALLY AND VIBRATIONALLY INELASTIC COLLISIONS BETWEEN He AND H_2. McGuire, P.; Micha, D. A. (Univ. of Florida, Gainesville). Int. J. Quant. Chem., Symp.; No. 6, 111-132 (1972).

From International Symposium on Atomic, Molecular and Solid-State Theory and Quantum Biology; Sanibel Island, Florida, United States of America (USA) (17 Jan 1972).

See CONF-720127-.

The coupled-channel formalism was employed for He + H_2 collisions including rotational (j = 0.2) and vibrational (n = 0.1) levels and making use of the Kraus–Mies potential energy surface. Integral and differential cross sections were obtained at the total energies 0.3884, 0.9, and 1.4116 eV for rotational and vibrational transitions separately, and for the combined processes. Considerable use was made of the microscopic reversibility principle to extract cross sections from the S matrix for de-excitations as well as for excitations. Cross sections for vibrational excitation were found to decrease when accompanied by rotational excitation. For vibrational de-excitation, the effect of rotational excitation is to increase the cross sections. Defining a most probable impact parameter $\bar{b}_{max}$ from the maximum in the partial integral cross sections, vibration excitation was found to occur at low $\bar{b}_{max}$, while rotational excitation was observed at comparatively higher values. For simultaneous rotational and transitions, $\bar{b}_{max}$ decreased with increasing energy transfer. A deflection angle $\Theta^{(cl)}$ was defined in terms of the impact parameters and the turning point radii for the initial and final channels, and a correlation between this angle and the maxima in the computed angular distributions was found. The transition probabilities for the rotational excitation j = 0 → 2 with simultaneous vibrational excitation and their physical interpretation are also discussed in the total angular momentum coupling scheme. (auth)

20744 EXCITATION OF $O_2^1\Delta_g$ BY ELECTRON IMPACT. Julienne, P. S.; Krauss, M. (National Bureau of Standards, Washington, DC). J. Res. Nat. Bur. Stand.; 76A: No. 6, 661-663 (1972).

The total and differential cross sections as a function of energy were calculated for electron impact excitation of the $O_2^1\Delta_g$ state from the ground $^3\Sigma_g^-$ state. The Ochkur-Rudge approximation was used for the exchange amplitude, which was calculated using Hartree-Fock wave functions with a Gaussian basis. There is good agreement with the experimental total cross section except near threshold. (auth)

20745 ANALYTIC EVALUATION OF INTEGRALS IN VARIATIONAL CALCULATIONS OF SCATTERING THEORY. Oberio, R. S.; Callaway, J.; Seiler, G. J. (Louisiana State Univ., Baton Rouge). J. Comput. Phys.; 10: No. 3, 466-474 (Dec 1972).

Analytic procedures are presented for the evaluation of the free–free exchange integrals which occur in the variational approach to scattering theory. Expressions are obtained which are suitable for numerical calculation on a computer. The method is based on a (known) analytic formula for the complex Laplace transform of the exponential integral function. (auth)

20746 NEON K X-RAY YIELDS ON Be, C, Mg, Al, AND Ti BOMBARDMENTS. Shima, K.; Takasaki, M.; Terashima, Y.; Sakai, S. (Kyoto Univ.). Phys. Lett., A; 42A: No. 7, 505-506 (29 Jan 1973).

Ne–K X-rays have been measured when various thick targets were irradiated by $Ne^{+,++}$ ions. For Mg, Al and Ti targets, the X-ray yield dependence on Ne energy agrees qualitatively with the electron promotion model prediction. (auth)

20747 INNER SHELL IONIZATION IN ION–ATOM COLLISIONS. Bardsley, J. N. (Univ. of Pittsburgh). Comments At. Mol. Phys.; 3: No. 6, 173-180 (Nov 1972).

The comments presented, relating to ionization by ion impact, were stimulated by contributions and discussions at the International Conference on Inner Shell Ionization, Atlanta, April 1972. (UK)

Atomic Theory

20748 (HU-TFT-72-19) SECOND-ORDER MAGNETIC HYPERFINE INTERACTIONS IN ONE-ELECTRON ATOMS: CONNECTIONS BETWEEN THE SCHROEDINGER, DIRAC, AND QUANTUM ELECTRODYNAMICAL PERTURBATION CALCULATIONS. Latvamaa, E.; Kurittu, L.; Tataru, L.; Pyykkoe, P. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). Aug 1972. 25p.

Second-order hyperfine interactions are considered for a one-electron atom, treating the nucleus as a point magnetic dipole of infinite mass and charge Z. The dominant contribution to the hyperfine splittings in the 1s and 2s states if found to arise from the ultrarelativistic continuum. In the high momentum limit the Schroedinger calculation gives a linear divergence while the Dirac and QED calculations give a logarithmic divergence. This explains why the nonrelativistic variational result of Gregson, Hall and Rees (1970) is too large by a factor of 10^3. The Dirac result is $\frac{3}{4}$ of the QED result, $(\frac{3}{4})(\alpha/\pi)(\mu m/M)\ln(p_{max})$, because of a missing retardation term. The Schroedinger and Dirac residuals are in good agreement. (auth)

20749 THEORY OF THE HYPERFINE STRUCTURE OF FREE ATOMS. Armstrong, Lloyd Jr. New York; John Wiley and Sons, Inc. (1971). 217p.

This book attempts to provide the background for a study of the theory of atomic hyperfine structure. The entire field of interactions between the nucleus and electrons of an atom is analyzed, using elementary Lie theory and second-quantization techniques. Hyperfine structure of samarium is discussed. Author and subject indexes are included. (184 references) (DLC)

20750 THEORETICAL STUDY OF A SPIN HAMILTONIAN WITH BIQUADRATIC PAIR INTERACTIONS. Oran, E. S. New Haven; Yale Univ. (1972). 165p. University Microfilms Order No. 72-33,030.

Thesis (Ph.D).

This work is a study of the statistical mechanics of a spin-one Hamiltonian with competing bilinear and biquadratic nearest neighbor interactions:

$$H = -\sum_{i,j} J' T_i^1(i) T_j^1(j) - \sum_{i,j} J\, T_i^1(i) T_j^1(j) - D \sum_j T_j^2(i) - H \sum_j T_j^1(i).$$

The two order parameters needed to describe this system are $M = \langle T_j^1 \rangle$, the z component of the dipole moment, and $Q = \langle T_j^2 \rangle$, the zz component of the quadrupole moment. Molecular field theory is derived by applying a single site approximation to a free energy inequality of Bogoliubov. A short proof of this inequality is given. It is also shown that if molecular field theory

is used, if interactions are between nearest neighbors only, and if the lattice is bichromatic, at most two sublattices are needed to describe the system. The Hamiltonian above has been studied for all values, positive and negative, of the interaction parameters J, J', D, and H. For certain limits of these parameters, molecular field results are compared to those of better approximations and exact calculations. This indicates where the approximation is inadequate and gives insight into the region of competing interactions where no exact results are available. When H = D = O, the ordering of M and Q is discussed as a function of J/J'. When $|J| > J'$, M = O and Q undergoes a first order (J > O) or second order (J < O) transition. For J' > J, M and Q have the same transition temperatures. These are first order for $\frac{1}{2} < J/J' \leq 1$ and otherwise they are second order. Near $J/J' = -1$, a ferrimagnetic region exists and M and Q may have three second order phase transitions. When D ≠ O and H ≠ O, the system can undergo multiple phase transitions which depend on the values of the interaction parameters. Zero temperature energy balances for fixed values of these parameters indicate the kinds of orderings present. The D-T (H = O) and H-T (D = O) phase diagrams are examined in detail and it is indicated in what regions of the planes the various phases occur. Keeping in mind the D-T (H = O), the H-T (D = O), and the D-H (T = O) behavior, the three dimensional D-H-T phase diagrams are described as J and J' vary. Though the D-T (H = O) diagrams have the same form for positive and negative J', the D-H-T diagrams differ greatly from these for small $|H|$ because of the introduction of the antiferromagnetic phase. The phase diagrams are similar for large $|H|$. An exhaustive study familiarizes one with some of the effects high order pair interactions can produce in real systems. (Diss. Abstr. Int., B)

20751 TOWARDS AN UNDERSTANDING OF THE FORM OF CORRELATED WAVEFUNCTIONS FOR ATOMS. Handy, N. C. (University Chemical Lab., Cambridge, Eng.). J. Chem. Phys.; 58: No. 1, 279-287(1 Jan 1973).

The transcorrelated method enables energies and properties to be found from correlated wavefunctions $C\Phi$. The purpose here was to give some rules, for small atoms, to write down correlation functions $C = \Pi_{i>j} f(r_{ij})$ which when multiplied into Φ, a suitable linear combination of Slater determinants, give an accurate correlated wavefunction $C\Phi$. For the He isoelectronic series a form can be found for $f(r_{ij})$ in which the only correlation parameter is Z, the nuclear charge, such that $C\Phi_{SCF}$ gives transcorrelated energies within 0.003 a.u. of the exact energy (Z = 1,2,3,10). This form of $f(r_{ij})$ is extended to atoms with two shells, so that f depends upon parameters Z_1 if r_i and r_j are in the first shell, and Z_2 if they are in the second shell. Through independent assessments of the accuracy of these wavefunctions for Be, C, O, and Ne, rules can be given for Z_1 and Z_2. Using these rules, the predicted correlation energies of eight such atoms were calculated and found to be reasonably accurate. (auth)

20752 TENSOR POLARIZABILITY AND RELATED PARAMETERS. Fano, U. (Univ. of Chicago); Deslattes, R. D. Comments At. Mol. Phys.; 3: No. 6, 187-190(Nov 1972).

The polarizability of an atom or molecule is a scalar for systems of zero angular momentum or of random orientation but is otherwise a tensor. The traceless part of this tensor, which has the symmetry of a quadrupole, is usually small because experimental circumstances prepare atomic systems in states of weak anisotropy or more specifically, with a low degree of alignment. The long established Kerr effect and, even more, the expanding arrays of techniques for producing alignment and for detecting its effects, however, lay considerable interest on the quadrupole polarizability and on a set of related parameters. These and other related matters are discussed. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

Refer also to abstracts 20852 and 20928.

20753 (AD-748766) MAGNETOHYDRODYNAMIC PIPE FLOW WITH LAMINAR SEPARATION. Summary Technical Report. Ranger, K. B. (Wisconsin Univ., Madison. Mathematics Research Center). Jun 1972. Contract DA-31-124 ARD(D)-462. 36p. (MRC-TSR-1237). NTIS.

A new solution is found from the MHD pipe flow equations which exhibits the reverse flow phenomenon when the Hartmann number exceeds a certain critical value. The reverse flow region separates from the wall of the channel at a second higher Hartmann number, and the variation of the critical Hartmann number with changes in geometry of the boundary is discussed numerically. The induced magnetic field also demonstrates a similar phenomenon and changes its direction after the fluid velocity changes sign. The flow is also discussed in relation to its expansion in terms of the Hartmann number. (auth) (NTIS)

20754 HALL CURRENT EFFECTS ON WAVES IN AN ELECTRICALLY CONDUCTING ROTATING FLUID. Sarma, M. S.; Rao, A. R. (Indian Inst. of Tech., Madras). Appl. Sci. Res. (The Hague); 27: No. 2-3, 118-128(Dec 1972).

The waves generated by an obstacle moving with constant velocity U along the axis of an inviscid, incompressible, infinitely conducting fluid with Hall current effects, rotating with an angular velocity Ω are studied by Lighthill's technique. Three cases arise accordingly as $U > A_1$, $U = A_1$, or $U < A_1$, where A_1 is the modified Alfven velocity due to Hall current term. In the cases $U >$ and $< A_1$ the wave-number surface consists of two distinct spheres and four coincident planes. The waves corresponding to the points on the outer sphere trail behind and those on the inner sphere travel ahead of the disturbance if $U > A_1$ and vice versa if $U < A_1$. When $U = A_1$ the wave-number surface consists of two coincident spheres and four coincident planes and the spherical waves are found both ahead and behind. By drawing appropriate normals to the four planes, it is seen that the formation of the Taylor column ahead of the disturbance is possible in all the cases. (auth)

20755 MAGNETOHYDRODYNAMIC LAMINAR SOURCE FLOW BETWEEN TWO PARALLEL DISKS. Khader, M. S.; Goodling, J. S. (Auburn Univ., AL). Appl. Sci. Res. (The Hague); 27: No. 2-3, 93-102(Dec 1972).

The steady axisymmetrical laminar source flow of an incompressible conducting fluid between two circular parallel disks in the presence of a transverse magnetic field is analytically investigated. A solution is obtained by expanding the velocity and the pressure distribution in terms of a power series of $1/r$. Velocity, induced magnetic field, pressure and shear stress distributions are determined and compared with the case of the hydrodynamic solution. Pressure is found to be a function of both r and z in the general case and the flow is not parallel. At high magnetic fields, the velocity distribution degenerates to a uniform core surrounded by a boundary layer near the disks. (auth)

20756 HYDROMAGNETIC FLOW BETWEEN TWO ROTATING DISKS. Srivastava, R. B. (Univ. of Lucknow, India). Indian J. Phys.; 46: No. 8, 355-362(Aug 1972).

The hydromagnetic flow of a viscous, incompressible and electrically conducting fluid confined between two rotating disks was studied. It is assumed that the lower disk is infinitely thin and the upper disk is of finite thickness. A series solution is obtained which is valid when Reynolds number (R) is less than the magnetic parameter (M^2). (auth)

20757 HYDROMAGNETIC STABILITY OF LAMINAR BOUNDARY LAYER ALONG A FLAT PLATE AT ZERO INCIDENCE. Kobayashi, R. (Tohoku Univ., Sendai). Z. Angew. Math. Phys.; 23: No. 3, 341-352(1972). (In German).

The stability for wavelike disturbances is considered in the steady, two-dimensional, laminar boundary layer of an incompressible, electrically conducting fluid along a flat plate in the presence of a magnetic field, which is applied uniformly normal to the flat plate. The results show that the critical Reynolds number (R_c^*) increases remarkably with the characteristic parameter (σ). The increase of the critical Reynolds number depends not only on the shape parameter of the velocity distribution in the boundary layer but also on the peculiarity of the velocity profile. It is also found that the boundary layer holds itself laminar all over the flat plate, when the magnetic parameter N is greater than 1.25×10^{-7}, then a reduction of the skin-friction drag might be expected. (auth)

20758 HYDRODYNAMIC STABILITY OF AN INSULATING FLUID DURING THE SPACE CHARGE LIMITED UNIPOLAR TRANSITORY INJECTION REGIME. Atten, Pierre (CNRS, Grenoble, France). Compt. Rend., Ser. A; 275: No. 16, 769-772(16 Oct 1972). (In French).

The stability problem encountered when an insulating fluid is subjected to a current step causing an intense unipolar injection was investigated. Studies of the amplification of the perturbations demonstrate that the conduction model used does not account for the observed motion of the liquid in the transitory regime with a sufficient accuracy. (France)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 21120.

20759 (IFVE-SEF-71-79) SOME REMARKS ON SEARCH FOR QUARKS AT THE IHEP 70-GeV ACCELERATOR. Zaitsev, A. M.; Landsberg, L. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 35p. (In Russian). INIS.

An analysis and comparison was made of the results of the different experiments on the search for quarks made using an accelerator and in cosmic radiation. For calculation of the spectrum of quarks, the phase space model and a phenomenological model, taking into consideration the fundamental characteristics of the generation of heavy particles in strong interaction, was used. It was shown that in the broad mass range M_Q = 2 to 7 GeV/c^2 the results of the IFVE have a very high sensitivity. (tr-auth)

20760 SEARCH FOR FRACTIONALLY CHARGED PARTICLES. Garris, E. D. Jr. Charlottesville, VA; Univ. of Virginia (1972). 95p. University Microfilms Order No. 72-33,360.

Thesis (Ph.D).

A search for fractionally charged particles (quarks) was performed using a beams type magnetic suspension. The suspension supports small (0.2 mm diameter, 30 μg) steel spheres in the center of a parallel plate capacitor. In the presence of a uniform electric field E, a force F = QE is exerted on the sphere when it carries a charge Q. This force is balanced with a magnetic servo system so that the current in the balancing magnet is proportional to the charge of the sphere: Q = KI. Our measured value for the charge of the electron e agrees to within 1% with the value obtained from an absolute calibration. Quarks would evidence themselves in our apparatus through the existence of an irreducible residual fractional charge. The distribution of residual fractional charge would have peaks at 0, $\pm\frac{1}{3}$, and $\pm\frac{2}{3}$e, if free quarks are contained within the sample spheres. We have measured the charge of twelve spheres and obtained a residual fractional charge distribution having peaks with the appropriate spacing to verify the existence of free quarks. Due to its importance, we prefer not to make the claim that we have discovered quarks without additional data. We report an apparatus capable of accurately measuring the residual fractional charge of small spheres. The data which we have collected with this apparatus are quite suggestive that free quarks exist. (Diss. Abstr. Int., B)

20761 DISCONTINUITIES IN HISTOGRAM SCALE TRANSFORMATION. Salomon, M. (Univ. of British Columbia, Vancouver). Nucl. Instrum. Methods; 106: No. 3, 609-610(1973).

Some types of linear changes in scale in histograms can produce irregularities or discontinuities. This effect is analyzed and methods to avoid it are proposed. (auth)

Electromagnetic

Refer also to abstracts 19919 and 20474.

20762 (CONF-710974-7) ELECTROPRODUCTION EXPERIMENTS. Heinloth, K. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). 1972. 79p. (In German). Dep. NTIS (U. S. Sales Only).

From Autumn conference on high energy physics; Hamburg, Germany (13 Sep 1971).

An introduction to the problems of electron scattering experiments using electron accelerators is presented. Experiments, results, and experimental apparatus were reviewed. (tr-auth)

20763 (DESY-72/66) EXPERIMENTAL VERIFICATION OF THE KRAMERS-KRONIG RELATION AT HIGH ENERGY. Alvensleben, H.; Becker, U.; Biggs, P. J. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Nov 1972. 11p. Dep. NTIS (U. S. Sales Only).

The real part of the forward amplitude for Compton scattering on protons was measured through the interference between the Compton and the Bethe-Heitler amplitude by detecting the zero degree electron pairs asymmetrically. The measurement was made at an average photon energy of $\langle k \rangle$ = 2.2 GeV, and an average momentum transfer to the recoil proton $\langle t \rangle = -0.027$ (GeV/c)^2. The result confirms the prediction of the Kramers-Kronig relation. (auth)

20764 (DESY-72/67) ELECTROPRODUCTION WITH A STREAMER CHAMBER FOR $0.3 < Q^2 < 1.5$ GeV^2, $m_p \leq W < 2.8$ GeV. Eckardt, V.; Gebauer, H. J.; Joos, P.; Meyer, H.; Naroska, B.; Notz, D.; Podolsky, W. J.; Wolf, G.; Yellin, S.; Dau, H.; Drews, G.; Greubel, D.; Meincke, W.; Nagel, H.; Rabe, E. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Dec 1972. 62p. Dep. NTIS (U. S. Sales Only).

Electroproduction in the kinematical region $0.3 < Q^2 < 1.5$ GeV^2, $m_p \leq W < 2.8$ GeV has been studied with a streamer chamber at DESY. The average multiplicity of charged hadrons is found to be somewhat smaller (~10%) than for photoproduction. The normalized π^- inclusive momentum spectra show less leading negative pions with increasing Q^2. The reaction $ep \rightarrow ep\pi^+\pi^-$ has been analyzed. The mass distributions show strong Δ^{++} formation at low energies and dominant ρ^0 production for high energies. The cross sections for Δ^{++} and ρ^0 production have been determined by maximum likelihood fits. The ratio of ρ^0 to total inelastic production drops with Q^2 from 16.6 ± 0.8% at Q^2 = 0 to 7.6 ± 2.1% (4.3 ± 2.9%) at $\langle Q^2 \rangle$ = 0.6 (1.04) GeV^2. The t distribution for events in the ρ mass region becomes increasingly flat with Q^2. The ρ^0 decay angular distribution has been analyzed in the helicity system. Near threshold (1.7 < W < 2 GeV) the ρ^0 mesons are longitudinally polarized. For higher energies more transversely aligned ρ^0 mesons are being produced. Under the assumption of s-channel helicity conservation the ratio $R = \sigma_L(ep\rho^0)/\sigma_T(ep\rho^0)$ is found to be 0.30 ± 0.14 at $\langle Q^2 \rangle$ = 0.6 GeV^2, $\langle W \rangle$ = 2.3 GeV. (auth)

20765 (SLAC-PUB-1092) OBSERVATION OF SMALL S-CHANNEL HELICITY FLIP AMPLITUDES IN VECTOR MESON PHOTOPRODUCTION. Ballam, J.; Chadwick, G. B.; Eisenberg, Y.; Kogan, E.; Moffeit, K. C.; Seyboth, P.; Skillicorn, I. O.; Spitzer, H.; Wolf, G.; Bingham, H. H.; Fretter, W. B.; Podolsky, W. J.; Rabin, M. S.; Rosenfeld, A. H.; Smadja, G. (Stanford Linear Accelerator Center, Calif; California Univ., Berkeley. Lawrence Berkeley Lab). Aug 1972. 13p. (CONF-720954-17; LBL-1055). Dep. NTIS.

From 16th International Conference on High Energy Physics; Batavia, Illinois, United States of America (USA) (6 Sep 1972).

Evidence is presented that although s-channel helicity conservation is dominant in ρ^0 photoproduction, a small amount of helicity flip which is not strongly dependent on photon energy occurs for dipions near the ρ^0 mass. The ratio of helicity single-flip to non-flip amplitudes at the γ-ρ vertex is comparable in magnitude to that found in πp scattering. (auth)

20766 PHOTOPRODUCTION OF X^0 MESONS. Loe, R. S. Ithaca, NY; Cornell Univ. (1972). 94p. University Microfilms Order No. 73-348.

Thesis (Ph. D.).

An experiment has been performed at the Wilson Synchrotron Laboratory to measure the photoproduction of X^0 mesons (958 MeV), $\gamma + p \rightarrow X^0 + p$, at an incident photon energy of 6 GeV and momentum transfer of -0.4 (GeV/c)^2. The process was identified by detecting the two decay photons from the X^0 in coincidence with the recoil proton. The resulting cross section, $(S - m_p^2)^2\, d\sigma/dt$ = 10.4 ± 4.9 μb-GeV^2, is compared with a theory for photoproduction of π^0 and η^0 mesons in the comparable kinematic range. (Diss. Abstr. Int., B)

20767 ANGULAR DISTRIBUTIONS OF THE ASYMMETRY OF THE REACTION $\gamma n \rightarrow \pi^- p$ ON A LINEARLY POLARIZED BEAM OF PHOTONS WITH ENERGIES 300, 400, and 500 MeV. Ganenko, V. V.; Gorbenko, V. G.; Zhebrovskii, Yu. V.; (and others) (Physical-Technical Inst., Kharkov). JETP Lett. (USSR) (Engl. Transl.); 16: No. 9, 380-381(5 Nov 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis-ma Red.; 16: No. 9, 535-537(5 Nov 1972).

The reaction $\gamma + n \rightarrow \pi^- + p$, which permits a more detailed investigation of the isotopic structure of the multipole amplitudes and helps to explain the role of the P_{11} resonance in single photoproduction processes, is studied. The angular dependences of the pion production cross section asymmetry are measured. (JFP)

20768 TIME-LIKE ELECTROMAGNETIC STRUCTURE OF THE HADRONS. Silvestrini, V. (Comitato Nazionale per l'Energia Nucleare, Frascati, Italy). pp 337-364 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol. 2).

Data about hadron production from e^+e^- experiments in the time-like region (around 1 GeV) are discussed. (France)

20769 NEUTRAL PION PHOTOPRODUCTION FROM PROTONS AT FORWARD ANGLES IN THE ENERGY REGION BETWEEN 350 MeV AND 1175 MeV. Hemmi, Y. (Kyoto Univ.); Inagaki, T.; Inagaki, Y.; Maki, A.; Miyake, K.; Nakamura, T.; Tamura, N. Tsukamoto, J.; Yamashita, N.; Itoh, H.; Kobayashi, S.; Yasumi, S.; Yoshida, H. Phys. Lett.; 43B: No. 1, 79-84(8 Jan 1973).

The differential cross section for the reaction $\gamma p \rightarrow \pi^0 p$ at forward angles was measured in the energy region between 350 MeV and 1175 MeV. A phenomenological multipole analysis was carried out on the present data together with other data. (auth)

Weak

20770 INELASTIC INTERACTIONS OF 5.0 GeV/c POSITIVE MUONS WITH EMULSION NUCLEI. Cruty, M. R. Potsdam, NY; Clarkson Coll. of Tech. (1973). 133p. University Microfilms Order No. 73-1300.

Thesis.

Inelastic 5.0 GeV/c positive muon-nuclei interactions, which result in disintegrations that form visible stars in the emulsion, are investigated. This investigation includes the entire range of four momentum transfer (q) and energy transfer from the lower to the upper limits established by kinematics. Events with three or more prongs are shown to result from pion production while 1 + 1 and 2 + 1 events are dominated by nuclear interactions (as opposed to interactions with individual nucleons in the nucleus) in which pions are not produced. The 1 + 1 data are consistent with production through the giant dipole resonance. Comparison of the 2 + 1 data with the quasi-deuteron model, which assumes that the interaction is with a proton-neutron pair in the nucleus, only results in a fit to the data when a form factor for the entire nucleus rather than for a deuteron is used. Events in which no pions, one pion, and more than one pion are seen to emerge from the nucleus, are compared and shown to be due to the same basic process. A fit to the pion production data is obtained for $q^2 \gtrsim 1000$ MeV^2, without normalization, by the Hand cross section for incoherent lepton interactions with individual nucleons in the nucleus, for $\sigma_s = 0$ and $F_p(q) = (1 + q^2/0.365)^{-2}$. However, at lower values of q^2, the data rise well above the prediction of the Hand cross section for incoherent interactions. The q^2 distribution for these anomalous data is shown to agree with the assumption that the excess results from nuclear rather than nucleon interactions. A composite form factor is obtained from phenomenological arguments and is shown to be in good agreement with all the data over the entire kinematical range of q^2. (Diss. Abstr. Int., B)

20771 TEST OF THE $\Delta I = \frac{1}{2}$ RULE AND THE LEE–SUGAWARA RELATION IN THE DECAY $\Sigma^+ \rightarrow p\pi^0$. Lipman, N. H. (Rutherford High Energy Lab., Chilton, Eng.); Uto, H.; Walker, T. G.; Montgomery, T. A.; Solomonides, C. M.; Bellamy, E. H.; Anderson, J.; Crawford, J. F.; Osmon, P. E.; Strong, J. A.; Vickery, R. P.; Walker, R. N. F. Phys. Lett.; 43B: No. 1, 89-92(8 Jan 1973).

The decay parameters α_0 and γ_0 were determined for the decay $\Sigma^+ \rightarrow p\pi^0$ by measuring the polarization of the decay protons by scattering in an aluminum-plate spark chamber. Under the assumption of time reversal invariance and small final-state interactions, analysis of 1259 useful scatters yielded $\alpha_0 = -0.96^{+0.05}_{-0.035}$ and $\gamma_0 = +0.28^{+0.14}_{-0.18}$. (auth)

20772 NEUTRINO '72. VOLUME II. EUROPHYSICS CONFERENCE, BALATONFUERED, HUNGARY, JUNE 11–17, 1972. Frenkel, A.; Marx, G. (eds.). Budapest; OMKDK Technoinform (1972). 349p. (CONF-720651-(Vol. 2)).

From Symposium on Neutrino 1972; Balatonfuered, Hungary (11 Jun 1972).

The conference included 17 papers, all of which were separately abstracted. (JFP)

For abstracts of individual papers see: 20773–20780, 20864, 20865, and 20875–20881.

20773 PRELIMINARY RESULTS ON THE RATIO OF ANTINEUTRINO TO NEUTRINO TOTAL CROSS SECTIONS. Aachen, Brussels, CERN, Paris, Milan, Orsay, London Collaboration pp 29-38 of Neutrino '72. Vol. II. Frenkel, A. (ed.). Budapest; OMKDK-Technoinform (1972).

From Symposium on Neutrino 1972; Balatonfuered, Hungary (11 Jun 1972). See CONF-720651-(Vol. 2).

Preliminary results of the CERN 1971 neutrino experiment using the heavy liquid bubble chamber Gargamelle are presented. The ratio of antineutrino to neutrino cross sections from 1 to 6 GeV was found to be R = 0.42 ± 0.08. (JFP)

20774 HYPERON PRODUCTION BY ANTINEUTRINOS IN GARGAMELLE. Aachen, Brussels, CERN, Paris, Milan, Orsay, London Collaboration pp 39-48 of Neutrino '72. Vol. II. Frenkel, A. (ed.). Budapest; OMKDK-Technoinform (1972).

From Symposium on Neutrino 1972; Balatonfuered, Hungary (11 Jun 1972). See CONF-720651-(Vol. 2).

The total cross section was found for single Λ production by antineutrinos with an energy of 1 to 10 GeV reacting in a heavy-liquid bubble chamber. This cross section is $1.3(10)^{-40}$ cm^2/proton. (JFP)

20775 NEUTRINO PHYSICS AT BATAVIA: PROSPECTS AND PROGRESS. Barish, B. C. (California Inst. of Tech., Pasadena). pp 49-73 of Neutrino '72. Vol. II. Frenkel, A. (ed.). Budapest; OMKDK-Technoinform (1972).

From Symposium on Neutrino 1972; Balatonfuered, Hungary (11 Jun 1972). See CONF-720651-(Vol. 2).

Experimental research on neutrino is summarized emphasizing the use of high energy neutrinos and the most probable early results. (JFP)

20776 COSMIC RAY NEUTRINOS. Reines, F. (Univ. of California, Irvine); Chen, H. H.; Gurr, H. S.; Kropp, W. R.; Landecker, P. B.; Lathrop, J. F.; Sandie, W. G.; Sobel, H. W.; Crouch, M. F.; Sellschop, J. P. F.; Bourne, D.; Coxell, H.; Kramer, D.; Meyer, B. S. pp 199-221 of Neutrino '72. Vol. II. Frenkel, A. (ed.). Budapest; OMKDK-Technoinform (1972).

From Symposium on Neutrino 1972; Balatonfuered, Hungary (11 Jun 1972). See CONF-720651-(Vol. 2).

The reactions of cosmic neutrinos with nuclei in rock above 100 MeV are studied. The muon angular distribution and horizontal neutrino induced muon flux are found. From the data limits are set on the $(\nu_\mu + \bar{\nu}_\mu)$ flux possibly associated with gravitational radiation. (JFP)

20777 ANALYSIS OF COSMIC RAY MUON NEUTRINO EXPERIMENTS. Osborne, J. L.; Wolfendale, A. W.; Young, E. C. M. (Univ. of Durham, Eng.). pp 223-237 of Neutrino '72. Vol. II. Frenkel, A. (ed.). Budapest; OMKDK Technoinform (1972).

From Symposium on Neutrino 1972; Balatonfuered, Hungary (11 Jun 1972). See CONF-720651-(Vol. 2).

The review covers the horizontal neutrino induced muon flux, the magnitude of neutrino intensities, and the neutrino interaction cross sections. (JFP)

20778 SEARCH FOR NEW LEPTONIC PROCESSES UNDERGROUND. Cassiday, G. L. (Univ. of Utah, Salt Lake City). pp 239-251 of Neutrino '72. Vol. II. Frenkel, A. (ed.). Budapest; OMKDK-Technoinform (1972).

From Symposium on Neutrino 1972; Balantonfuered, Hungary (11 Jun 1972). See CONF-720651-(Vol. 2).

Preliminary results of a search for those underground muon and neutrino interactions which yield large hadronic cascades are presented. The existence of locally produced muons including the hadronic cascade multiplication process is directly confirmed, but no evidence is found for the Turin effect in the rates for these interactions. (JFP)

20779 ATMOSPHERIC NEUTRINO INDUCED MUON FLUX AND THE NEUTRINO NUCLEON INTERACTIONS AT HIGH ENERGIES. Kunszt, Z. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 253-272 of Neutrino '72. Vol. II. Frenkel, A. (ed.). Budapest; OMKDK-Technoinform (1972).

From Symposium on Neutrino 1972; Balatonfuered, Hungary (11 Jun 1972). See CONF-720651-(Vol. 2).

Calculations of the horizontal muon flux from atmospheric ν_μ + N interactions at high energies are presented. (JFP)

20780 PROSPECTS FOR THE DETECTION OF HIGHER ORDER WEAK PROCESSES AND THE STUDY OF WEAK INTERACTIONS AT HIGH ENERGY. Cline, D. (Univ. of Wisconsin, Madison). pp 273-318 of Neutrino '72. Vol. II. Frenkel, A. (ed.). Budapest; OMKDK-Technoinform (1972).

From Symposium on Neutrino 1972; Balatonfuered, Hungary (11 Jun 1972). See CONF-720651-(Vol. 2).

The discussion covers the range and strength of weak interactions and the rate for higher-order weak processes, lepton–lepton collisions, semi-leptonic processes, nonleptonic processes, and high energy neutrino scattering. (JFP)

Strong (Baryon-induced)

Refer also to abstract 20883.

20781 (IFVE-SPK-71-1) INVESTIGATION OF p–p INTERACTIONS AT 70 GeV IN THE BUBBLE CHAMBER "MIRABELE." (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 13p. (In Russian). INIS.

An experiment on the investigation of the general characteristics of proton–proton interactions at an energy of 70 GeV in the bubble chamber "Mirabele" was reported. The multiple generation of particles and the diffraction dissociation of nucleons were the basic processes studied in the first series. (tr-auth)

20782 (JINR-P1-6928) PRODUCTION OF γ-QUANTA IN π^-N INTERACTIONS AT 40 GeV/c. Budapest-Bucharest-Warsaw-Dubna-Krakow-Serpukhov-Sofia-Tashkent-Tbilisi-Ulan Bator-Hanoi Collaboration. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 22p. (In Russian). Dep. NTIS (U. S. Sales Only).

Data are presented on an average multiplicity of π^0 mesons in π^-p-, π^-n-, and π^-^{12}C-interactions at 40 GeV/c obtained using the 9432 γ-quantum statistics. Growth of an average number of π^0 mesons is pointed out in these interactions depending on the charged particle multiplicity. In the distribution $(1/\sigma_{in})/(d\sigma/dy^*) = f(y^*)$ for γ-quanta from π^-p interactions a plateau is observed in the range $-1 \lesssim y^* \lesssim +1$, and the absolute cross section value in $y^* = 0$ region coincides with the corresponding cross section for pp interaction at E_p = 500 to 1500 GeV. Thus, in the central region ($y^* \approx 0$) there takes place a scaling for π^-p interactions at P = 40 GeV/c. (auth)

20783 (JINR-P16-6729) QUASIALBEDO OF HIGH ENERGY HADRONS OUT OF CONCRETE AT INCIDENT PROTON ENERGY OF 9 GeV. Grigor'ev, V. A.; Zaitsev, L. N.; Issinskii, I. B.; Kimel, L. R.; Novikov, S. A.; Sidorin, V. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1972. 11p. (In Russian). Dep. NTIS (U. S. Sales Only).

We present experimental and calculated data on quasialbedo of high energy hadrons out of concrete shielding bombarded by 9 GeV protons. The experimental investigation of the quasialbedo has been performed at the JINR synchrophasotron where a 9 GeV proton is extracted. The characteristics of the quasialbedo are measured by detectors using the reaction $^{12}C \rightarrow {}^{11}C$. The quasialbedo of high energy hadrons are calculated by the Monte Carlo method as well. The experimental data are compared with the calculated ones. (auth)

20784 (LNF-72/89) PROCESSES WITH THE PRODUCTION OF BARYONS AT ADONE. Ambrosio, M.; Barbiellini, G.; Bemporad, C.; (and others) (Comitato Nazionale per L'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati.). 13 Oct 1972. 28p. (In Italian). Dep. NTIS (U. S. Sales Only).

An experiment is proposed to obtain data on the reaction $e\bar{e} \rightarrow p\bar{p}$ with high geometric efficiency and in the angle interval from 30 to 150° with respect to the beam. A general description is given of the experimental apparatus. The measurement techniques are described in detail and the arrangement for the acquisition of data is discussed. (JSR)

20785 USING AN ON-LINE COMPUTER IN HIGH-ENERGY PHYSICS EXPERIMENTS. Moritz, J. (Kernforschungszentrum, Karlsruhe, Ger.). KFK Nachr.; 4: No. 2, 10-14(1972). (In German).

Several years ago, a team of the Institut fuer Experimentelle Kernphysik has set up an experiment at the Deutsches Elektronen-Synchrotron (DESY) in Hamburg for investigating the structure of the proton and neutron by means of electron scattering. The experimental devices include a computer for the recording and preliminary analysis of measured data. The present report describes the function of the computer as a necessary auxiliary means for the recording of data, and as the connecting link between the measuring devices and the experiment. (auth)

20786 MULTIPLE PRODUCTION OF HADRONS AT COSMIC RAY ENERGIES (EXPERIMENTAL RESULTS AND THEORETICAL CONCEPTS). Feinberg, E. L. (Lebedev Inst. of Physics, Moscow). Phys. Rep.; 5C: No. 5, 237-351(Dec 1972).

Experimental cosmic ray data on hadron interactions are reviewed. Specific features of cosmic ray experiments and specific methods used are briefly described. The data which may be considered as definitely established and accepted by all cosmic ray investigators are separated from those results which are not yet proved but, being of utmost importance, deserve serious attention. Besides, some indications of possible new phenomena at laboratory impinging energy $E_L \sim 10^4 - 10^5$ GeV are described. Among the most essential suggestions arising from cosmic ray studies particularly stressed are: first, the division of produced particles into two groups—pionization (these constitute an overwhelming majority of final particles) and leading ones—with sharply different kinematic properties; second, the tendency of multiple production of particles to proceed via formation of clusters, whose properties correspond to those of a statistical system with temperature of the order of the pion mass. Theoretical ideas, models and theories pertaining to multiple production are viewed. It is shown that actually both popular and discarded ones use rather few basic principles. The pionization and interaction of produced particles among themselves are essential for interpretation of experimental data. The dominating process at very high energy seems to be a peripheral process with statistical subsystems included in a peripheral or multiperipheral scheme. With the energy range of $E_L \lesssim 10^3$ GeV scaling holds for leading particles and fails to be valid for the pionization ones. The true asymptotics may appear only at higher energy. (auth)

20787 ANTIPROTON–DEUTERON FINAL STATES WITH NO NUCLEONS AT 2.2 GeV/c. Manweiler, J. E. Lawrence, KS; Univ. of Kansas (1972). 149p. University Microfilms Order No. 72-32,904.

Thesis (Ph.D).

The results presented were obtained from a bubble chamber analysis of $\bar{p}$d interactions at an incident $\bar{p}$ momentum of 2.2 GeV/c. The final states studied are of the type $\bar{p} + d \rightarrow \Lambda + K + n\pi$. Final states with a Σ^0 instead of a Λ or with an additional pair of kaons are included. A total of 634 fitted and unfitted events of this type were isolated from a sample of events with identified lambdas. The total cross section for these lambda-kaon type events is found to be 297 ± 33 microbarns. For comparison, the total cross section for the final state $\bar{p} + d \rightarrow \Lambda + \bar{\Lambda} + n$ (spectator) at the same energy is 89 ± 14 microbarns. The predominate multiplicity of pions in these lambda-kaon type events is four. Two, three, and four-body effective masses have been examined for principal lambda-kaon final states. The principal result of this study is the lack of predominate resonance production in any of these final states. This result may be compared to the results of this same $\bar{p}$d exposure where annihilations into kaons and pions yields K* (890) production in the range of 50 percent for some final states. Various mechanisms for the production of these events are examined. Much of the mechanism discussion by Camerini et al., of Wisconsin is shown to be incorrect. Two step processes where a final state particle from the $\bar{p}$N interaction interacts with the remaining nucleon are shown to be reasonable by a crude classical model. Secondary interactions involving intermediate kaons and pions are shown to predominate over those involving intermediate antilambdas. The results show that the spectator nucleon hypothesis is not as useful as is generally accepted. Consequences of the involvement of both nucleons of the deuteron should be carefully considered in deuterium experiments. An interesting aspect is the confusion of the identity of the nucleon involved in the antiproton-nucleon interaction when charge exchange scattering occurs with the remaining nucleon. Another aspect is that secondary elastic scattering may contribute to the observed high momentum tail in the spectator nucleon momentum distribution. (Diss. Abstr. Int., B)

20788 SOME RECENT BUBBLE CHAMBER RESULTS FROM ARGONNE NATIONAL LABORATORY. Musgrave, B. (Argonne National Lab., IL). pp 485-515 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333–(Vol.1).

Some results obtained for line reversed reactions are compared. The $K^-p \rightarrow K^{*0}(890)n$ process was studied from a $K^-p \rightarrow K\pi^+n$ bubble chamber experiment at 5.5 GeV/c. A Reggeized absorption model involving π, ρ, A_2 exchanges was used to quantatively describe the difference in $d\sigma/dt$ between the $K^-p \rightarrow \bar{K}^{*0}(890)n$ reaction and its line reversed partner $K^+n \rightarrow K^{*0}(890)p$. The cross section for the $K^+p \rightarrow K^{*+}(890)p$ reaction at 2.52, 2.76 and 3.20 GeV/c, fully corrected for all decay modes is shown together with results for the line reversed $K^-p \rightarrow K^{*-}(890)p$ reaction. Recent data obtained for $\bar{p}p \rightarrow \pi^-\pi^+$ and $\bar{p}p \rightarrow K^-K^+$ reactions at 2.3 GeV/c are compared with a baryon exchange model based on the line reversed $\pi^+p \rightarrow p\pi^+$ and $K^+p \rightarrow pK^+$ reactions. Strong absorption effects are discussed. (France)

20789 NUCLEON DIFFRACTION DISSOCIATION. Vander Velde, J. C. (Univ. of Michigan, Ann Arbor). pp 141-160 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333–(Vol.2).

Results obtained for nucleon diffraction dissociation reactions of the $N \rightarrow N + \pi$ type are described. For $-t' < .1$, the diffraction dissociation of 25-30 GeV/c neutrons with a carbon target gives a mass spectrum very similar to that obtained with 23 GeV/c neutrons colliding a K^+ target; there is no evidence for resonances. Angular distributions provide further evidence for the lack of resonance production at small $-t'$. (France)

20790 CHARGED PARTICLE PRODUCTION AT THE CERN–ISR. Giacomelli, G. (Univ., Bologna). pp 275-303 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel les-Allues, France (5 Mar 1972). See CONF-720333–(Vol.2).

The characteristics of the CERN Intersecting Storage Rings (ISR) are briefly reviewed. The experimental results on the production of charged particles in proton-proton collisions up to 52-GeV c.m.s. at the ISR are given (this energy range corresponds to 1500 GeV = 1.5 TeV for a proton beam colliding with a stationary proton). Results are compared with lower energy data and with the predictions of theoretical models such as the scaling hypothesis or the limiting distribution hypothesis. (France)

20791 EXPERIMENTAL RESULTS ON INCLUSIVE REACTIONS AT VERY HIGH ENERGIES. Leveque, A. (CEN de Saclay, Gif-sur-Yvette, France). pp 321-333 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333–(Vol.2).

Data obtained from inclusive distributions measured in non-ISR inelastic proton-proton collision experiments above 30 GeV are presented. The rapidity distributions obtained from emulsion experiments have been fitted with multiperipheral models and diffractive models, the results obtained are good. New average multiplicity plots at 50 and 70 GeV were obtained from a bubble chamber experiment at Serpukhov; they are in good agreement with the results obtained with emulsions. (France)

20792 FOUR-PRONG PP-INTERACTIONS AT MOMENTUM 19.1 GeV/c. Takibaev, Zh. S.; Boos, E. G.; San'ko, L. A.; Mukhordova, T. I.; Mosienko, A. M.; Zaitsev, K. G.; Sharapov, K. V. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 16: No. 5, 974-982(1972). (In Russian).

General dynamical characteristics of secondaries, produced in four-prong pp-interactions at the initial momentum 19.1 GeV/c in a 2m hydrogen bubble chamber, are being discussed. There are presented secondary momentum spectra, and mean number of pions and protons per one interaction, besides the energy fraction, spent on pion production has been estimated. Correlations between four-dimensional transfers to nucleons, going to different hemispheres in the cms, are considered. (auth)

20793 TOTAL ELASTIC p–p, p–d, p–n CROSS SECTIONS IN THE ENERGY RANGE OF 1 TO 70 GeV. Beznogikh, G. G.; Buyak, A.; Nikitin, V. A.; Shafranova, M. G.; Sviridov, V. A.; Truong Bien; Vikhlyantseva, L. V.; Zayachki, V. I.; Zolin, L. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Phys. Lett. 43B: No. 1, 85-88(8 Jan 1973).

The total elastic p–p, p–d, and p–n cross sections measured at the Serpukhov accelerator and Dubna synchrophasotron are presented. (auth)

20794 COMPARISON OF CHARACTERISTICS FOR PROTON AND NEUTRON INTERACTIONS WITH C, Fe, Pb NUCLEI. Azaryan, M. O.; Mamidzhanyan, E. A.; Martirosov, R. M.; Suleimanov, R. A. (Inst. of Physics, Erevan). Yadern. Fiz.; 16: No. 6, 1231-1237(1972). (In Russian).

The results on measuring of characteristics of proton and neutron interactions with light (carbon), average (iron) and heavy (lead) nuclei in the energy region of 6.10^{11}–3.10^{13} eV at a mountain altitude station "Aragats" are given. It is shown that in all these interactions the behavior of protons and neutrons are similar in the limits of cosmic experiment errors. (auth)

20795 TOTAL CROSS SECTION MEASUREMENT IN THE MOMENTUM RANGE UP TO 65 GeV/c BY HODOSCOPE METHOD. Bushnin, Yu. B.; Gorin, Yu. P.; Denisov, S. P.; (and others) (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 16: No. 6, 1224-1230(1972). (In Russian).

The total cross sections for interactions of protons, pions, kaons and antiprotons with protons and deuterons in the momentum range up to 65 GeV/c are measured by a hodoscope installation. The direct experimental comparison of two methods for determining total cross sections (the hodoscope method and transmission counter method) is carried out. This experimental comparison shows, that these methods give compatible results. (auth)

Strong (Meson-induced)

Refer also to abstracts 19929 and 20903.

20796 (JINR-P1-6846) FOUR-PRONG EVENTS IN π^-p INTERACTIONS AT 5 GeV/c. Berlin-Bucharest-Dubna-Kosice-Ulan-Bator Collaboration. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1972. 32p. (In Russian). Dep. NTIS (U. S. Sales Only).

The cross sections of the reaction channels and those of resonance production in four-prong π^-p interactions at 5 GeV/c are determined. The events are distributed over the Van-Hove sectors; the results are compared with the Van-Hove analysis at higher energies. (auth)

20797 LOW-ENERGY SPECTRUM OF $\pi\pi$ MASSES IN THE REACTION $\pi^-p \to \pi^+\pi^-n$ AT 400 MeV. Makarov, M. M.; Gasilova, N. S.; Nelyubin, V. V.; Sarantsev, V. V.; Tkach, L. N. (Leningrad Inst. of Nuclear Physics). JETP Lett. (USSR) (Engl. Transl.); 16: No. 9, 368-370(5 Nov 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 9, 518-522(5 Nov 1972).

An investigation of the low-energy $\pi\pi$ mass spectrum in the reaction $\pi^- + p \to \pi^+ + \pi^- + n$ at 550 MeV/c in emulsions was made to search for narrow resonances in the $\pi\pi$ system and to estimate the possibility of determining the $\pi\pi$ scattering length. The absolute cross section was found and effective mass distributions are shown. (JFP)

20798 REACTION $\pi^-p \to \rho N$ AT 4.5 GeV/c. Barish, S. J. Philadelphia; Univ. of Pennsylvania (1972). 257p. University Microfilms Order No. 73-1356.

Thesis.

We present the analysis of 47,000 two-prong events observed in π^-p interactions at 4.5 GeV/c from a 160,000 picture exposure of the SLAC 82" hydrogen bubble chamber. The events were measured by the University of Pennsylvania's Hough–Powell Device, the output of which was processed by the automatic track following and minimum guidance event recognition computer programs developed at our laboratory. The single pion production events are dominated by ρ^- production in the $\pi^-\pi^0$ system and ρ^0 and f^0 production in the $\pi^-\pi^+$ system. Evidence for ω^0 exchange in ρ^- production is seen from a comparison of the production and decay angular distributions for the ρ^- and the ρ^0 for $15 < \Delta^2/\mu^2 \leq 100$. We observe little evidence for natural parity exchange in ρ^0 production from the shape of the angular distributions and the values of the density matrix element ρ_{1-1} in this Δ^2 region. Our data for ρ^0 production also indicate that $d\sigma/d\Delta^2(\pi^-p \to \rho^0 n)$ does not go to 0 at $\Delta^2 = 0$, contrary to the pseudoperipheralism assumption used in evasive Chew–Low extrapolations. Comparisons of our ρ^0 production data with single pion photoproduction data with linearly polarized photons reveal discrepancies in the vector dominance model predictions, particularly for $|t| > 5\ \mu^2$. In the multipion production events we observe the reactions

$$\pi^-p \to \underset{\pi^-\eta^0}{A_2^-}p,\ \pi^-p \to \rho^0\,\underset{\pi^+\pi^-\ \text{neutrals}}{\Delta^0(1238)},$$

and $\pi^-p \to \underset{\pi^+\pi^-\ \text{neutrals}}{f^0\,\Delta^0(1238)}$. (Diss. Abstr. Int., B)

20799 REACTIONS $\pi^+d \to \pi^+\pi^-pp_s$ AND $\pi^+d \to \pi^+\pi^-\pi^0pp_s$ AT 8 GeV/c. Horne, C. P. Philadelphia; Univ. of Pennsylvania (1972). 145p. University Microfilms Order No. 73-1400.

Thesis (Ph.D).

The reactions $\pi^+d \to \pi^+\pi^-pp_s$ and $\pi^+d \to \pi^+\pi^-\pi^0pp_s$ were studied at an incident π^+ beam momentum of 7.88 GeV/c. The first reaction was found to be dominated by the formation of the ρ, f, and g boson resonances. We have studied the mass dependence of the dipion partial waves and shown that the J^P of the g (1670) boson is probably 3^- and presented evidence for a narrow enhancement in the D wave at about 1050 MeV. In the reaction $\pi^+n \to \pi^+\pi^-\pi^0pp_s$, we have studied 3π resonances ω, A, and φ (1680), and the simultaneous production of ρ and Δ. We studied the production mechanism of the ω, and found evidence for the reaction $\pi^+n \to \epsilon^0\Delta^+$. (Diss. Abstr. Int., B)

20800 SOME RESULTS FROM A STUDY OF $\pi^-p \to \rho^0\phi^0$ AT 15 GeV/c. Leith, D.W.G.S. (Stanford Linear Accelerator Center, CA). pp 263-298 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333–(Vol.1).

The reaction $\pi^-p \to \rho^0\phi^0$ was studied for small momentum transfers at an incident momentum of 15 GeV/c. Signs for a pion exchange in the region $t <= M(\text{pion})^2$ were found. The density matrix elements and cross sections obtained strongly evidenced the existence of absorptive corrections. A simplified version of OPEA was applied to the data for πn and $\pi\Delta$, the result strongly supports the presence of absorptive effects in the OPE process. The same data were used to study $\pi-\pi$ scattering at the pion pole and a useful set of phase shifts was obtained. (France)

20801 EXCHANGE MECHANISMS IN SOME RESONANCE PRODUCTION REACTIONS. Gidal, G. (Univ. of California, Berkeley). pp 401-429 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol. 1).

The following two examples of resonance production reactions are discussed: $\pi^+p \rightarrow \eta^0\Delta^{++}$ and $\pi^+p \rightarrow \rho^+p$; data were extracted from 300,000 pictures at 2.67 GeV/c. The cross sections were studied as functions of the incident momentum and a power law behavior appeared to be a good approximation for both reactions above 2.3 GeV/c and 2 GeV/c, respectively. (France)

20802 JOINT DECAY CORRELATIONS IN $\pi^+p \rightarrow V^0\Delta^{++}$ REACTIONS AT 3.7 GeV/c. Barnham, K.W.J. (European Organization for Nuclear Research, Geneva). pp 459-483 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol. 1).

Data from 16,445 events and 16,617 events corresponding to $\pi^+p \rightarrow p\pi^+\pi^+\pi^-$ and $\pi^+p \rightarrow p\pi^+\pi^+\pi^-\pi^0$ respectively were analyzed, and joint decay correlations were studied. The statistics were sufficient to demonstrate the t′ dependence of the correlations, exhibit the correlations visually, confirm the success of the Bialas-Zalewski quark model predictions, and make a start on the extraction of amplitudes and phases from the data. (France)

20803 SOME RESULTS ON INCLUSIVE REACTIONS OBTAINED IN BUBBLE CHAMBER EXPERIENCE. Stroynowski, R. (European Organization for Nuclear Research, Geneva). pp 77-97 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allus, France (5 Mar 1972). See CONF-720333-(Vol. 2).

Results obtained with inclusive reactions in meson-proton collisions below 30 GeV are discussed from the data for $\pi^\pm p$ at 8 GeV/c, $\pi^\pm p$ at 16 GeV/c and K^-p at 10 GeV/c. The limiting fragmentation hypothesis and the scaling hypothesis are successively examined. The leading particle effect is introduced from a comparison of the momentum spectra of pions produced in π^+p and π^-p collisions at 16 GeV/c. The problem of asymmetry in the production of pions in meson-proton collisions is also envisaged. (France)

20804 TWO-PION CORRELATIONS IN K^+p INTERACTIONS AT 11.8 GeV/c. Lander, R. L. (Univ. of California, Davis). pp 257-274 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol. 2).

The correlations observed between the pion pairs produced in the inclusive $K^{++}p \rightarrow \pi^+\pi^+x$ reaction at 11.8 GeV/c are described. (France)

20805 NEUTRAL PION PRODUCTION AT THE ISR. Schubert, K. R. (European Organization for Nuclear Research, Geneva). pp 305-319 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol. 2).

Angular and energy distributions for single-photon production in proton-proton collisions at $\sqrt{s}$ = 30 to 53 GeV were measured at the CERN Intersecting Storage Rings (ISR). Data obtained are summarized. Conclusions are drawn for π^0 production and data are compared with $\pi^\pm$ production data. (France)

20806 ANALYSIS OF THE EXPERIMENTAL DATA ON SECONDARY PARTICLE MULTIPLICITY IN π^-p-, π^-n-, AND π^-C-COLLISIONS AT P = 40 GeV/c. Dubna-Bucharest-Budapest-Krakow-Hanoi-Serpukhov-Sofia-Tashkent-Tbilisi-Ulan-Bator-Warsaw Collaboration Yadern. Fiz.; 16: No. 5, 989-995(1972). (In Russian).

Data on the multiplicity of charged (secondary) and neutral particles in π^-p-, π^-n- and π^-C-interactions at p = 40 GeV/c are compared. The charged particle multiplicity distribution in π^-p- and π^-n-interaction is well described by the model in which $(\pi^+\pi^-)$ pairs are assumed to be distributed by the Poisson law (model Wang-I) and by phenomenological formulas. The $n_\pm$ dependence of $\langle n_{\pi^0}\rangle$ is presented. The average number of π^0-mesons increases with increasing the number of charged particles. For all π^-p- and π^-n-interactions $\langle n_{\pi^0}^{\pi^-p}\rangle = 2.51 \pm 0.06$ and $\langle n_{\pi^0}^{\pi^-p}\rangle / \langle n_\pm^{\pi^-p}\rangle = 0.45 \pm 0.02$, $\langle n_{\pi^0}^{\pi^-n}\rangle = 2.39 \pm 0.08$ and $\langle n_{\pi^0}^{\pi^-n}\rangle / \langle n_\pm^{\pi^-n}\rangle = 0.45 \pm 0.02$ were obtained. (auth)

20807 MISSING-MASS SPECTRA OBSERVED IN REACTION $\pi^- + p \rightarrow p + X^-$ AT 25 AND 40 GeV/c. Antipov, Yu. M.; Busnello, R.; Vaich, A.; Damgaard, G.; Ech, F. A.; Kintsle Fokachchi, M. N.; Kintsle, V.; Klanner, R.; Landsberg, L. G.; Lebedev, A. A.; Leshanuan, K.; Lekont, P.; Marten, M.; Roinishvili, V. N.; Sard, R. D. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 16: No. 5, 996-1002(1972). (In Russian).

The results on studying missing-mass spectra with zero strangeness for the mass interval $0 < M_X < 4.5$ GeV and in the momentum transfer range $0.17 < |t| < 0.35$ (GeV/c)^2 are being treated in the paper. In the range of low masses (<2 GeV) one can observe an enhancement with $M_X = 1.3$ GeV and $M_X = 1.7$ GeV. There are no statistically significant structures for X^- spectrum in the high mass range (>2 GeV). (auth)

20808 MEASUREMENTS OF $K^-p \rightarrow \bar{K}^0n$ CHARGE-EXCHANGE CROSS-SECTIONS AT 25 AND 35 GeV/c. Belousov, V. I.; Bolotov, B. N.; Devishev, M. I.; Isakov, V. V.; Kakauridze, D. B.; Karpekov, Yu. D.; Kachanov, V. A.; Konstantinov, V. F.; Kut'in, V. M.; Lednev, A. A.; Makarov, G. M.; Postoev, B. E.; Prokoshkin, Yu. D.; Prokhorov, A. N.; Semenov, V. K.; Sergeev, V. A.; Simonov, Yu. N.; Sugonyaev, V. P. (Inst. for High Energy Physics, Serpukhov, USSR). Phys. Lett.; 43B: No. 1, 76-78(8 Jan 1973).

Results are presented on the reaction $K^-p \rightarrow \bar{K}^0n$ for momenta above 20 GeV/c. Events were identified by precise measurement of the opening angle in the decay $K^0 \rightarrow \pi^+\pi^-$ without using a magnetic field. The energy dependence of the cross section is described by a power function. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstracts 20958, 20968, and 21564.

20809 (COO-3067(2)-14) MULTIPLICITY DISTRIBUTION IN THE MULTIPERIPHERAL MODEL AND A ONE-DIMENSIONAL GAS. Lee, T. D. (Columbia Univ., New York). 1972. Contract AT(11-1)-3067. 46p. Dep. NTIS.

The multiplicity distribution at high energy in the multiperipheral model for the Φ^3 theory is shown to be identical to the grand canonical ensemble distribution of a particular one-dimensional gas with only repulsive forces, which can be decomposed into two-body, three-body, and other multi-body forces. The specific form of these forces and the corresponding virial expansion of the gas system are discussed. An alternative systematic expansion method is developed, which is different from the virial series but appears to be of a greater practical value for this particular class of physical problems. (auth)

20810 (IFVE-STF-71-43) BEHAVIOR OF THE RATIO OF ELASTIC CROSS SECTION AND.THE TOTAL CROSS SECTION AT HIGH ENERGIES. Volkov, G. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 7p. (In Russian). INIS.

The possible behavior of the elastic cross section to the total cross section was investigated within the framework of the quantum field theory. (tr-auth)

20811 (IFVE-STF-71-57) INVESTIGATION OF BINARY REACTIONS OF HADRONS BY THE DISPERSION RELATION METHOD. Solov'ev, L. D. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 17p. (In Russian). INIS.

The use of the dispersion relation was investigated for the experimental investigation of the difference of the total scattering cross section of mesons and antimesons at high energy by the measurement of the cross section of the reaction of charge exchange or regeneration at zero angles. The most recent data on the differential cross sections of positive and negative pions at energies of 30 to 60 GeV were analyzed. (tr-auth)

20812 (IFVE-STF-71-88) LOWER BOUND OF DECREASE OF DIFFERENTIAL CROSS SECTIONS FOR AN INCLUSIVE PROCESS AT HIGH ENERGIES. Logunov, A. A.; Mestvirishvili, M. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 7p. (In Russian). INIS.

At the present time interest in the study of inelastic processes with one isolated final particle "c" has increased. The processes have the name inclusive. On the basis of hypotheses on the analyticity through cos Q, where Q is the angle of the origin of the particle in the center of mass system, and polynomial limitedness, the lower boundary of the decrease of the differential cross section of the inclusive process $(d\delta c)/d\cos Q$ was established in the range of large angle during $S \rightarrow \infty$. (tr-auth)

20813 (JINR-P2-6827) SCALE DIMENSIONALITY OF AXIAL CURRENT AND $\sigma\pi\pi$ PEAK. Dao Vong Dyc (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 12p. (In Russian). Dep. NTIS (U. S. Sales Only).

Scale dimensionality is calculated for the time component of the axial current. The $\sigma\pi\pi$ peak is considered based on the law of scale transformation of current. The obtained expression agrees well with experiment. (auth)

20814 (JINR-P2-6833) BACKWARD SCATTERING PROCESSES AT HIGH ENERGIES IN QUASIPOTENTIAL APPROACH. Garsevanishvili, V. R.; Goloskokov, S. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 9p. (In Russian). Dep. NTIS (U. S. Sales Only).

High energy backward scattering is considered in the framework of the quasipotential approach. Taking into account the exchange forces in the two-particle system leads to the nonvanishing contribution in the vicinity of small u. Scattering of scalar particles is studied as well as their scattering by spinor particles. (auth)

20815 (NP-19671) NEW VARIABLES FOR THE STUDY OF TRANSVERSE MOMENTUM CORRELATIONS IN MULTIPARTICLE PROCESSES. Korkea-aho, M.; Nyborg, P. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). Aug 1972. 22p. Dep. NTIS (U. S. Sales Only).

A new set of transverse momentum variables is introduced in the description of two-particle inclusive reactions, giving an alternative approach to the study of correlations in transverse momenta. (auth)

20816 (RLO-2041-82) ANNUAL REPORT, 1972. Moravcsik, M. J. (Oregon Univ., Eugene. Inst. of Theoretical Science). 31 Oct 1972. AT(45-1)-2230. 7p. Dep. NTIS.

Research on high energy physics theory is summarized and covers very high energy models, Regge cuts, dispersion relations, polarization models, general phenomenology, the two-nucleon problem, pion-nucleon bremsstrahlung, and laser accelerators. A list of publications is included. (JFP)

20817 POSITIVE DEFINITE FORMS FOR WAVE FUNCTIONS OF PARTICLES WITH ARBITRARY SPIN. Henning, J. J. (Atomic Energy Board, Pretoria); Wolf, W. pp J.1-8 of Fifth Annual Seminar on Theoretical Physics. Pretoria; Atomic Energy Board (1970).

From 5th annual seminar on theoretical physics; Pretoria, South Africa (13 Jul 1970). See CONF-700728.

Matrix elements of field operators with $2s + 1$ components to describe particles with total spins and Z-component $\sigma = -s, -s+1, \ldots$ are studied. Quantized field operators with arbitrary spin and the basis spinors for transformation properties of wave functions are covered. (JFP)

20818 PERTURBATION THEORY FOR NONDERIVATIVE NONPOLYNOMIAL LAGRANGIANS. Taylor, J. G. (Univ. of Southampton, Eng.). J. Math. Phys. (N.Y.); 14: No. 1, 68-78(Jan 1973).

We present a regularization scheme for deriving finite, unitary, and causal amplitudes to each order in the major coupling constant for nonderivative nonpolynomial Lagrangians for the self-interaction of massless neutral scalar particles. The results are shown to contain no arbitrary constants, though these may be introduced consistently into the superpropagator, the second-order contribution. (auth)

20819 U AND V SECTORS IN THE BRONZAN-LEE MODEL. Choudhury, A. L. (Elizabeth City State Univ., NC). J. Math. Phys. (N. Y.); 14: No. 1, 90-96(Jan 1973).

The Lehmann-Symanzik-Zimmermann (LSZ) formalism is used in the Bronzan-Lee model to investigate the scattering processes in the lowest sectors. In this model, there are three heavy recoilless particles U, V, and N interacting with a θ particle. The processes allowed are $U \rightleftharpoons V\theta$ and $V \rightleftharpoons N\theta$. In U and V sectors of this model all τ functions have been calculated, and relevant scattering and production amplitudes are evaluated. The mass, wavefunction, and vertex function renormalization constants have been found and they agree with the results previously obtained by Bronzan and later also by Liossatos. (auth)

20820 HIGH ENERGY PHYSICS INDEX. Volume 11, No. 3, 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 89p.

20821 SCALING AND HYDRODYNAMICAL THEORY FOR MULTIPLE PROCESSES. Daibog, E. I.; Nikitin, Yu. P.; Rozental, I. L. (Moscow State Univ.). Yadern. Fiz.; 16: No. 6, 1314-1317 (1972). (In Russian).

Predictions of field theories for multiple processes (in particular, scaling) are being compared with those of alternative model, i.e., hydrodynamical theory. It is remarked, that though the constructional basis of both are different on principle, the qualitative difference is small, and it is quite probable, that it lies within the accuracy of measurements and calculations. Importance of measuring multiplicity in the energy range (10^{13}-10^{14}) eV to make a choice between both approaches has been pointed out. (auth)

20822 RECURSIVE NUMERICAL INTEGRATION OF MULTIPARTICLE PHASE SPACE WITH PERIPHERAL MATRIX ELEMENT. Pirala, P.; Byckling, E. (Univ. of Helsinki). Comput. Phys. Commun.; 4: No. 1, 117-127(Oct 1972).

The program Peripheral Phase Space Integral written in FORTRAN IV for the UNIVAC 1108 is described for the calculation of the total cross section of a multiparticle final state as a function of total energy for elementary particle interactions. (JFP)

20823 BELYAEV-ZELIVINSKII BOSON EXPANSION AND PARTICLE-VIBRATION COUPLING METHODS IN AN EXACTLY SOLUBLE MODEL. Bes, D. R.; Evans, J. A.; Kraus, N. C. (Comision Nacional de Energia Atomica, Buenos Aires). J. Phys., A (London); 6: No. 1, 6-22(Jan 1973).

The Belyaev-Zelivinskii boson expansion and particle-vibration coupling methods are studied in comparison with an exact treatment of the monopole model. Two of the three boson expansions considered were valid for all interaction strengths. A third expansion and the particle-vibration coupling method were found to be equivalent to perturbation theory. The difficulty associated with the overcompleteness of the basis in the particle-vibration coupling method was resolved both in the computation of the energies and the matrix element of the monopole specific operator. (auth)

20824 PROCEEDINGS OF THE 7th RENCONTRE DE MORIOND. VOLUME 1. TWO BODY COLLISIONS. Conference Held at Meribel-les-Allues, France, March 5-17, 1972. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972). 523p. (CONF-720333-(Vol.1)).

The first session of the 1972 Rencontre de Moriond was devoted to two-body collision phenomenology. Twenty-six papers were presented and twenty-four of them have been abstracted for NSA. (France)

For abstracts of individual papers see: 20788, 20800-20802, 20825, 20886-20888, 20893, 20903, 20904, 20910-20919, 20933, 20976, and 20977.

20825 CONCLUSIONS OF THE FIRST SESSION. Sonderegger, P. (European Organization for Nuclear Research, Geneva). pp 518-523 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.1).

Present difficulties encountered in the field of high energy physics seem to be due to the lack of discoveries which follows the happy 1954-1965 period. Some useful scientific activities which might benefit from the experience, methods, and concepts of the high energy physicists are reviewed: medical applications, physics teaching and environment sciences. (France)

20826 PROCEEDINGS OF THE 7th RENCONTRE DE MORIOND. VOLUME 2. MULTIPARTICLE PHENOMENA AND INCLUSIVE REACTIONS. Conference Held at Meribel-les-Allues, France, March 5-17, 1972. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972). 496p. (CONF-720333-(Vol.2)).

The second session of the 1972 Rencontre de Moriond was devoted to multiparticle phenomena and inclusive reactions. Twenty-five papers were presented; twenty-three papers have been abstracted for NSA. (France)

For abstracts of individual papers see: 20768, 20789-20791, 20803-20805, 20827-20832, 20842-20846, 20889-20892, and 20934.

20827 CLUSTERING AND LEADING PARTICLE EFFECTS IN INCLUSIVE SPECTRA. Petersson, B. (Paris Univ., Orsay, France). pp 161-194 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.2).

A phenomenological approach of the one-particle inclusive spectra is presented. The energy range at which scaling is possibly satisfied is discussed, recent cosmic ray data being presented as evidence against scaling at very high energies. A recursion rela-

tion is presented for the one-particle spectra, using the distributions of the leading particles as a dynamical input. (France)

20828 CORRELATIONS IN INCLUSIVE EXPERIMENTS. Caneschi, L. (European Organization for Nuclear Research, Geneva). pp 195-226 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.2).

The kinematical correlations introduced by conservation laws in many-particle inclusive distributions are studied. Momentum conservation in a theory of identical bosons with no quantum numbers is first examined. In the case of particles with quantum numbers (charge, isospin, etc...), sum rules for inclusive distributions can be derived as a consequence of the existence of additively conserved quantum numbers. (France)

20829 REMARKS ON THE ASYMPTOTIC BEHAVIOR OF PARTIAL CROSS-SECTIONS. Le Bellac, M. (Univ., Nice). 243-256 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol. 2).

The behavior of the partial cross section $\sigma_n(s)$ for the production of n final particles (with $s = (p_a + p_b)^2$ and $1/s$ as the flux factor) is derived from the n-particle inclusive cross section in a Mueller-type approach. It is shown that the behavior of $\sigma_n(s)$ can be studied at fixed n, and varying s. $\sigma_n(s)$ is shown to decrease faster than any power of $(\ln s)^{-1}$ when s tends to infinity, if some assumptions about the Regge singularities are made. The hypothesis of short-range correlations being introduced, the Mueller generating function is defined and the asymptotic behavior of the central moments is derived. (France)

20830 EIKONAL FORMALISM FOR MULTIPARTICLE PRODUCTION. Jengo, R. (Univ., Trieste, Italy). pp 335-336 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.2).

A general formalism describing the processes in which two fast moving primary particles produce many secondary particles by collisions is introduced. (France)

20831 IMPRESSIONS AND CONCLUSIONS, MERIBEL 1972. Heusch, C. pp 457-462 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.2).

Comments on the two sessions of the 1972 Rencontre de Moriond are presented. Information supplied by the papers in both exclusive and inclusive approaches of particle interactions is discussed. (France)

20832 APPENDIX ON INCLUSIVE PHENOMENOLOGY. Petersson, B. (Paris Univ., Orsay, France). pp 463-487 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.2).

The main motivations, definitions, jargon and kinematics used in the field of multiparticle production (especially in the inclusive approach) are introduced: definitions of one-particle inclusive distributions, scaling conjecture, conservation laws and multiplicity, multiparticle inclusive distributions and inclusive-exclusive relations, invariant variables, Muellers optical theorem and triple Regge limit. (France)

20833 WEAK CONVERGENCE IN HILBERT SPACE AND WEAK UNCERTAINTY RELATIONS IN QUANTUM THEORY. Alvim, F.; Serpa, L.F.P. (Univ. of Brasilia, Brazil). Int. J. Theor. Phys.; 6: No. 6, 467-484(Dec 1972).

A suitable weak topology is considered on the Hilbert space of a quantum-mechanical system. It is then shown that if two bounded observables of the system have no common eigenvector, the sum of their variables in any state is always greater than some positive constant. Consequences of this result on some observables of simple physical systems are examined. First of all, the case of the position and momentum of the elementary particle in one dimension is studied and a comparison with Heisenberg's uncertainty principle is carried out. Then, the case of angular variables is also examined, with special emphasis on spin $\frac{1}{2}$. An experiment with neutrons is finally suggested and analyzed with the help of the theory developed. (auth)

20834 COVARIANT WAVE FUNCTIONS WITH INVARIANT HELICITY FOR MASSLESS PARTICLES. Simon, M. T.; Seetharaman, M.; Mathews, P. M. (Univ. of Madras). Int. J. Theor. Phys.; 6: No. 5, 399-406(Dec 1972).

A wave function ψ is considered for a massless particle, transforming according to an arbitrary irreducible representation (IR) of the homogeneous Lorentz group. The basic conditions are determined for ψ to be an eigenfunction with a specified value λ of the helicity in all Lorentz frames. The method used is direct and elementary, requiring no knowledge of the IR's of the Poincaré group. It is shown that there exists no invariant helicity state in unitary representations of the Lorentz group, and one such state in any non-unitary representation (with one extra in special cases). (auth)

Electromagnetic

Refer also to abstracts 20496, 20948, and 21221.

20835 (IFVE-STF-70-103) ELECTROMAGNETIC CORRECTIONS FOR TOTAL CROSS SECTIONS OF HADRON INTERACTIONS. Savrin, V. I.; Tyurin, N. E.; Khrustalev, O. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1970. 10p. (In Russian). INIS.

The contribution of the electromagnetic interaction to the difference of the scattering cross section of particles and antiparticles was calculated on the basis of the relativity equations of the attenuation quantum theory. (JSR)

20836 (IFVE-STF-71-52) ELECTROMAGNETIC NEUTRINO-NUCLEON SCATTERING. Andryushin, V. I.; Folomeshkin, V. N. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 6p. (In Russian). INIS.

The possibility of studying the electromagnetic interaction of neutrons in the process of neutrino-nucleon scattering at high energy was examined. (tr-auth)

20837 (JINR-E2-6666) INVESTIGATION OF REACTIONS $\gamma\gamma \to K\bar{K}$ AND $\gamma + \gamma \to \gamma + \gamma$ BY THE METHOD OF DISPERSION RELATIONS. Isaev, P. S.; Khleskov, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 14p. Dep. NTIS (U. S. Sales Only).

The process $\gamma + \gamma \to K + \bar{K}$ has been investigated by the method of dispersion relations with account of the two-pion intermediate state. The cross sections of the s- and d-waves of the process and of the interaction of the colliding beams ee $\to$ ee $K\bar{K}$ have been obtained. The contribution of the intermediate $K\bar{K}$-state to the reaction $\gamma\gamma \to \gamma\gamma$ has been calculated. (auth)

20838 ALGEBRAIC SOLUTION OF THE KLEIN-GORDON EQUATION. Nickle, H. H.; Beers, B. L. (Southern Illinois Univ., Carbondale). J. Phys., A (London); 5: No. 12, 1658-1663 (Dec 1972).

An algebraic approach to the solution of the Klein-Gordon equation is described for the case of a charged particle in the presence of plane-wave electromagnetic radiation. From an examination of the commutation relations between $P_\mu = -i\,(\delta/\delta x_\mu)$ and A_ν, P.A, A.A, etc., a new set of "translation" operators Π_μ is found which commutes with the total "Hamiltonian." A representation of the Poincaré group out of the Π_μ and their canonically conjugate "coordinates" Q_ν are constructed. The solutions are shown to correspond to the spin zero, mass m representation of the restricted Poincaré group. Applications of the technique to other quantum-mechanical problems are also briefly discussed. (auth)

20839 MASS DIFFERENCE OF THE ELECTRON AND THE MUON. Novello, M. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro); Armony, M. Notas Fis., Cent. Brasil. Pesqui. Fis.; 19: No. 3, 97-101(1972).

The mass difference of the electron and muon is determined from the actual structure of the universe starting with a modification of a unified model of weak and electromagnetic interactions by means of a Yang-Mills type theory of leptons. (JFP)

20840 STUDIES IN SCATTERING: LIGHT SCATTERING FROM A REACTIVE EULERIAN FLUID AND ELECTRON SCATTERING FROM ATOMIC HYDROGEN. Knirk, Dwayne Lee. Houston, Tex.; Rice Univ. (1972). 420p. University Microfilms Order No. 72-26,439.

Thesis.

There are two scattering studies described. The first is a thermodynamic calculation of the spectrum of light scattered from a reacting fluid. The second is a numerical solution of close coupled equations for the scattering of an electron by atomic hydrogen. (JFP)

20841 EMISSION THEORY AND SYNCHROTRON RADIATION. Vrcelj, Z. Spectrosc. Lett.; 6: No. 1, 73-75(1973).

The angular distribution of synchrotron radiation gives no evidence against the Ritz emission theory. (auth)

20842 SEMI-CLASSICAL RADIATION THEORY AND HIGH ENERGY MULTIPRODUCTION. Stodolsky, L. (Stanford Linear Accelerator Center, CA). pp 37-59 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.2).

The possible connections between high energy multiproduction by hadrons, and electrodynamic radiation processes are examined. An interpretation of the characteristics of the secondary spectrum is presented. An analogy between radiative tails or straggling in electrodynamics and leading particle behavior in hadron interactions is considered. A method for deriving in a simple way the radiative formulas for radiative tails and straggling is exposed. The phenomena are described using the basic assumption they have their origin in the statistical fluctuations of the radiation field. (France)

20843 e^+e^- ANNIHILATION INTO HADRONS: RESONANCES, REGGE POLES, FIXED POLES, SCALING, AND DUALITY. Renard, F. M. (Univ., Montpellier, France). pp 365-383 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.2).

The multiple production phenomena occurring in e^+e^- annihilation between 1 GeV and 2 GeV are analyzed. Cross sections are of the order of 10^{-32} cm^2 and decrease slowly with q^2. Descriptions previously proposed for this production are based on extensions of the vector dominance model and on the concept of scale invariance. A connection between these two different approaches, based on duality is proposed. (France)

20844 HADRONIC STRUCTURE OF THE PHOTON: PARTONS VERSUS VECTOR MESONS. Renard, F. M. (Univ., Montpellier, France). pp 385-403 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.2).

A description for e^+e^- annihilation into hadrons is presented using for photons the same parton model as for hadrons. The time-like photon at rest is considered as the superposition of configurations with N particles with a P(N) probability. A parton distribution is obtained for the momenta, this distribution is the superposition of an isotropic distribution and a $\sin^2\theta$ distribution depending on the spins and parity of the i(th) parton and of the remaining (N-1) state. Two kinds of process are envisaged for the complete $e^+e^- \rightarrow$ hadrons annihilation: a one-step process in which the final hadrons are directly the partons constituting the photon, a two-steps process in which the photons first decay into partons, each parton decaying then into a set of N′ hadrons. (France)

20845 INTRODUCTION TO THE POSITIVITY CONSTRAINTS ON ABSORPTIVE AMPLITUDES AND THEIR EXPERIMENTAL IMPLICATIONS. de Rujula, Alvaro (Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France). pp 405-428 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.2).

The positivity domain for the matrix elements of the forward Compton amplitude is defined and the relevant inclusive electroproduction and coincidence electroproduction experiments are briefly reviewed. The positivity domain of the absorptive non-forward Compton amplitude is then defined. Applications of positivity to the transverse polarization in elastic electron-proton scattering and outside the field of hadron electrodynamics are discussed: the two-channel positivity and the T-odd effects in quasi-elastic neutrino scattering, and the spin effects in hadron inclusive reactions. (France)

20846 SEARCH FOR HADRONIC FINAL STATES IN DEEPLY INELASTIC LEPTON-NUCLEON SCATTERING. Heusch, C. A. pp 429-452 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.2).

The present situation of the attempts to understand the scaling of electroproduction structure functions in terms of the hadronic final state channel is reviewed. Features observed and unexplained in high energy inelastic lepton-nucleon scattering are mentioned. Final state features are expressed in terms of models satisfying the scaling phenomenon and the validity of the models is discussed. The various experimental approaches currently followed in the field are presented. (France)

20847 GENERATION OF THE HIGHEST COSMIC-RAY ENERGIES, Grewing, M. (Univ., Bonn); Heintzmann, H. Phys. Lett., A; 42A: No. 5, 345-346(1 Jan 1973).

The acceleration of charged particles in superstrong electromagnetic fields to energies $> 10^{21}$ eV has been studied numerically, taking into account radiation reaction effects. (auth)

20848 ANOMALOUS FIELD DIMENSIONS AND ASYMPTOTIC SCALE INVARIANCE. Etim, E. (Univ., Naples). Nuovo Cim. A; 13A: No. 2, 427-445(21 Jan 1973).

Using Wilson-type expansions for the products of the hadronic electromagnetic current and particle fields, we derive expressions for the pion and nucleon structure functions which factorize into a product of the elastic form factor and the Källén-Lehmann spectral functions. The property that the contributions of the resonances to the structure functions survive in the deep inelastic limit despite the rapid decrease in momentum transfer of their excitation form factors is manifestly realized because the asymptotic power growth of the spectral function is well matched with the momentum transfer fall-off of the form factors. All this is possible only if the dimensions of the pion and nucleon fields are anomalous. If conformal invariance in all space-time is invoked then Bjorken scaling holds only if the fields have canonical dimensions. The resulting theory in this case is noninteracting and the Källén-Lehmann spectral functions have only the single-particle (delta-function) contribution. Comparison of our results with the predictions which follow from conformal-symmetry arguments reveals systematic disagreements indicating clearly that there is more dynamics in the phenomenon of Bjorken scaling that can be unravelled by appeal to conformal invariance only. (auth)

20849 CRITICAL EVALUATION OF THEORIES OF DIRECT ELECTRON PAIR PRODUCTION BY MUONS. Wright, A. G. (Polytechnic of North London). J. Phys., A (London); 6: No. 1, 79-92(Jan 1973).

The development of the theory of direct pair production by relativistic muons is traced in an attempt to reconcile the existing theoretical expressions for the cross section. The interrelation of the theoretical treatments and the shortcomings of approximate formulas are examined. Cross sections are expressed in a form suitable for numerical evaluation and a direct comparison of the formulas of various authors is made. Numerical calculations of energy loss-dE/dx are presented and compared with computations of other authors. (auth)

20850 MULTIPOLE INTERACTION HAMILTONIAN FOR TIME DEPENDENT FIELDS. Barron, L. D.; Gray, C. G. (Cambridge Univ., Eng.). J. Phys., A (London); 6: No. 1, 59-61(Jan 1973).

By a suitable choice of gauge, it is shown that the conventional Hamiltonian for the interaction of a system with time dependent electromagnetic fields can be written in multipole form without performing a canonical transformation. (auth)

20851 NONLINEAR LAGRANGIAN FOR TWO-PHOTON PRODUCTION OF SOFT PIONS. Malakyan, Yu. P. (Inst. of Physical Research, Erevan). Yadern. Fiz.; 16: No. 5, 1035-1043(1972). (In Russian).

Proceeding from the Weinberg-type Lagrangian for the pion-nucleon interaction and from requirement of gauge invariance an effective Lagrangian is obtained for the processes $\gamma\gamma \rightarrow k\pi_+ + k\pi_- + m\pi^0$ and $\gamma \rightarrow k\pi_+ + k\pi_- + m\pi_0$ where m is odd, containing one phenomenological constant, the vertex $\pi_0 \rightarrow 2\gamma$. (auth)

20852 SIGN OF CONSTANT OF ELECTROMAGNETIC DECAY $\pi^0 \rightarrow 2\gamma$. Terent'ev, M. V. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 16: No. 5, 1044-1050(1972). (In Russian).

Using the data on spectra in K_{e4}-decay and relation between vertices of $\gamma \rightarrow 3\pi$ and $\pi \rightarrow 2\gamma$ there has been established a relative sign of the constant of πN-coupling and of that in $\pi^0 \rightarrow 2\gamma$ decay in the framework of SU(3)-symmetry. The connection between the signs of π^--meson polarizability and the constant of $\pi^0 \rightarrow 2\gamma$ decay is being discussed. (auth)

20853 ELECTRON-POSITRON PAIR PRODUCTION. Zima, V. G. (Kharkov State Univ.). Yadern. Fiz.; 16: No. 5, 1051-1059 (1972). (In Russian).

Production of electron-positron pairs by polarized photons on nonpolarized nuclei with an arbitrary spin is being considered. The differential cross section in total 4-momentum, corresponding to the Bethe-Heitler diagrams, was calculated. Asymptotic ex-

pressions for total and differential in recoil asymuth cross sections were obtained by $\gamma + Z \rightarrow e^+ + e^- + Z$ reactions. (auth)

20854 VAVILOV–CHERENKOV EFFECT IN THE X-RAY RANGE. Kolpakov, A. V. (Moscow State Univ.). Yadern. Fiz.; 16: No. 5, 1003-1005(1972). (In Russian).

The possibilities of realizing the Vavilov–Cherenkov effect in the X-ray range of the wave lengths in the medium, containing nuclei with low-energy resonances, are being discussed. It is shown, that Cherenkov light intensity may be $4 \cdot 10^3$ quantum/cm at 1 μa current in the medium containing the Moessbauer isotope ^{57}Fe. (auth)

20855 ELECTRON AND MUONIC PRODUCTION IN e^-e^- AND e^+e^- COLLIDING BEAMS. Kuraev, E. A.; Lipatov, L. N. (Inst. of Nuclear Physics, Leningrad). Yadern. Fiz.; 16: No. 5, 1060-1077(1972). (In Russian).

Asymptotics of total cross section for $\mu^+\mu^-$-pair production was found with power accuracy in energy. As for e^+e^--pairs the contribution of diagrams of Bethe–Heitler type was calculated. The contribution of other diagrams is estimated using Mork's correction for the Borsellino formula. The case, when the initial energy is of order of mass of heavy particles produced, is also considered. (auth)

20856 POLARIZATION EFFECTS IN WEAK INTERACTION IN COLLIDING e^+e^--, e^-e^--BEAMS AT HIGH ENERGIES. Grigoryan, G. V.; Khoze, V. A. (Erevan Inst. of Physics). Yadern. Fiz.; 16: No. 5, 1078-1087(1972). (In Russian).

There is considered a dependence of weak and electromagnetic interaction contribution as well as electromagnetic and weak interactions interference term to the cross section for $e^+e^- \rightarrow \mu^+\mu^-$ and e^+e^- elastic scattering upon arbitrary polarizations of initial particles. The case of transverse polarizations is considered in detail. Polarization effects in $e^+e^- \rightarrow \tilde{\nu}\nu\gamma$ are discussed and it is shown, that the measurement of γ-quantum circular polarization might further an identification of this process. (auth)

20857 PHOTOPRODUCTION OF ($\pi\Delta$) ON PROTON AT PHOTON ENERGY 0.6 TO 1 GeV. Zayats, A. A. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 16: No. 5, 1088-1095(1972). (In Russian).

The reactions $\gamma N \rightarrow \pi\Delta$ were studied in the framework of the model, which takes into account contributions of the nucleon resonances N*(1470), N*(1519), N*(1652), N*(1672) and of singlepion gradient-invariant mechanism with account for lower partial wave absorption. The parameters of resonance contributions were found proceeding from the results of multipole analysis of $\gamma N \rightarrow \pi N$ and $\pi N \rightarrow \pi\Delta$. The phenomenological parameters, characterizing the degree of absorbing the waves with $J = 1/2, 3/2$, are determined from the best agreement with the experimental data on $\gamma p \rightarrow \pi^-\Delta^{++}$ reaction. (auth)

20858 $\gamma + \gamma \rightarrow \pi + \pi$ REACTION AND THE PION MASS ELECTROMAGNETIC DIFFERENCE. Isaev, P. S.; Khleskov, V. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 5, 1012-1022(1972). (In Russian).

The reaction $\gamma + \gamma \rightarrow \pi + \pi$ was studied by dispersion relations method. The cross sections of the process were calculated for two parametrizations of s wave $\pi\pi$ phase shift. The dependence of cross sections on the threshold and high energy phase-shift behavior and on inelasticity was investigated. The cross sections of the processes $e + e \rightarrow e + e + \pi + \pi$ were calculated. The pion electromagnetic mass was determined from $\gamma + \gamma \rightarrow \pi^+ + \pi^-$ amplitude. (auth)

20859 STRANGE PARTICLE ELECTROPRODUCTION ON NUCLEONS NEAR THE THRESHOLD. Krive, I. V. (Kharkov State Univ.). Yadern. Fiz.; 16: No. 5, 1006-1011(1972). (In Russian).

The amplitudes of the strange particle electroproduction on nucleons were obtained in the framework of relativistic gauge-invariant Born approximation at the energy threshold value. The limiting cases of large ($k^2 \gg m^2$) and small k^2 were considered. The sensitivity of cross section σ_T for nucleon magnetic form factor at large k^2 has been marked out. For small k^2 there are presented expressions for longitudinal parts of the amplitudes for $\gamma^*p \rightarrow \Sigma^+K^0$, $\gamma^*n \rightarrow \Sigma^-K^+$ reactions convenient to determine charge radii of Σ-hyperons and K-mesons. (auth)

20860 COMPTON SCATTERING FROM A RELATIVISTIC MAXWELLIAN DISTRIBUTION OF ELECTRONS BY THE DISCRETE S_n METHOD. Stephan, B. G. Wright–Patterson Air Force Base, OH; Air Force Inst. of Tech. (1971). 132p. University Microfilms Order No. 72-33,069.

Thesis (Ph. D.).

This research effort determined how to numerically represent the scattering kernel for X-ray scattering from a relativistic Maxwellian distribution of electrons in a multigroup discrete S_n treatment of the equation of radiative transfer. Ten sets of 134-group averaged Wien weighted cross section coefficients were calculated for electron temperatures between 0.5 and 20 keV, with photon energies between 0.05 and 400 keV. These 134-group cross sections were then collapsed to ten, twenty, and forty group cross section sets for use in parametric transmission studies using a discrete S_n transport code. Steady state transmission studies in which the source and electron temperatures were equal showed that the kernel is adequately represented by a two-term Legendre polynomial expansion. In optically thin regions an S_8 angular quadrature is sufficient for near-isotropic sources while S_{16} or higher quadratures are necessary for highly anisotropic sources. Steady state transmission studies in which the source temperature did not equal the electron temperature, but in which the cross sections were deliberately weighted by an equilibrium photon distribution, indicated that for 20 or fewer energy group models the ratio of source temperature to electron distribution temperature must lie in the interval $0.8 \leq T/T_e \leq 1.8$ if spectral errors are to be limited to five percent or less. (Diss. Abstr. Int., B)

20861 ANALYSIS OF PION PHOTOPRODUCTION AND THE QUARK MODEL. Moorhouse, R. G. (Univ. of Glasgow); Oberlack, H. Phys. Lett.; 43B: No. 1, 44-48(8 Jan 1973).

($N^*N\gamma$) couplings for resonances in the first, second, and third resonance region are determined in a continuous-energy partial-wave analysis of single-pion photoproduction off protons and neutrons using fixed-t dispersion relations. Several couplings are determined for the first time. Most results, especially for the principal resonances, agree well with the predictions of the quark model; but the P_{11} (1470), on its present unmixed multiple assignment, disagrees. (auth)

20862 FACTORIZATION AND INCLUSIVE ELECTROPRODUCTION. Lam, W. S. (Univ., Bielefeld, Ger.). Phys. Lett.; 43B: No. 1, 53-55(8 Jan 1973).

Inclusive electroproduction cross sections for π^+ in the fragmentation region of the proton are predicted via factorization from hadron-initiated reactions. Good agreement is found between prediction and existing data at $W = 3$ GeV and Q^2 varying from 0.3 $(GeV/c)^2$ to 1.2 $(GeV/c)^2$. The Q^2 dependence in the fragmentation region of the virtual photon is discussed via the energy conservation sum rule. (auth)

20863 DETERMINATION OF THE NMR GYROMAGNETIC RATIO OF DEUTERON IN D_2O. Frait, Z.; Gemperle, R. (Inst. of Physics, Prague). Czech. J. Phys.; 22: No. 12, 1259-1268 (1972).

Results of measurement of the ratio of the nuclear resonance frequencies of deuterons in D_2O and of protons in H_2O are given. From these measurements the gyromagnetic ratio of the deuteron in D_2O is evaluated as $\gamma_d/2\pi = 6.535670(23)$ $(10^2\ HzG^{-1})$. The experimental equipment and method are described, and the results are discussed in comparison with the measurements of other authors. (auth)

20864 SCALING PROPERTIES IN WEAK AND ELECTROMAGNETIC PROCESSES. Lee, T. D. (Columbia Univ., New York). pp 1-28 of Neutrino '72. Vol. II. Frenkel, A. (ed.). Budapest; OMKDK-Technoinform (1972).

From Symposium on Neutrino 1972; Balatonfuered, Hungary (11 Jun 1972). See CONF-720651-(Vol. 2).

The nature of the scaling property in various high energy weak and electromagnetic processes is reviewed. Then the theoretical basis of scaling and its implications for the future of high energy physics are discussed. (JFP)

20865 CALCULATION OF STATIC QUANTITIES IN WEINBERG'S MODEL. Bardeen, W. A.; Gastmans, R.; Lautrup, B. (CERN, Geneva). pp 163-173 of Neutrino '72. Vol. II. Frenkel, A. (ed.). Budapest; OMKDK Technoinform (1972).

From Symposium on Neutrino 1972; Balatonfuered, Hungary (11 Jun 1972). See CONF-720651-(Vol. 2).

The regularization scheme and the renormalizability of the Weinberg model are tested by calculations of static quantities. These quantities include the anomalous quadrupole moment of the charged intermediate boson, the g-2 of the W, the neutrino charge magnitude and radius, and the muon anomaly. (JFP)

20866 POSSIBLE EFFECT OF DIAGONALIZATION OF HIGH ENERGY ELECTROMAGNETIC INTERACTIONS OVER PARTICLE HELICITY. Lipmanov, E. M.; Mikheev, N. V. (Yaroslavl State Univ., USSR). Yadern. Fiz.; 16: No. 6, 1238-1243(1972). (In Russian).

The effect of high energy diagonalization of electromagnetic interactions over particle helicity, arising in the case of existence of hypothetic interaction between axial pseudoelectrical current

and heavy neutral boson. Physical consequences of such a hypothesis for leptonic reactions are being considered alongside with some possibilities for experimental observation of the effect in the experiments with high energy colliding beams in the range considerably lower than production threshold of intermediate boson. (auth)

20867 SOME BASIC QUESTIONS IN NUCLEON–NUCLEON BREMSSTRAHLUNG. Heller, L. (Los Alamos Scientific Lab., NM). pp 79-99 of Two-Body Force in Nuclei. Austin, S. M. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on the Two-Body Force in Nuclei; Ann Arbor, Michigan, United States of America (USA) (7 Sep 1971). See CONF-710915-.

The problem of the correct form of the electromagnetic current operator is considered when the Schroedinger equation has a nonlocal potential. By looking at the mesonic origin of exchange potentials and assuming the mesons are "minimally" coupled to the electromagnetic field, it is concluded that the minimal prescription for the nonlocal potential is generally wrong. Doing nothing about the momentum dependence of the potential corresponds to choosing a "maximal" current; this violates the soft-photon theorem but is gauge invariant. The correct current to associate with the exchange of a charged scalar meson is written down, and it is intermediate between the minimal and maximal choices. The implications for nucleon–nucleon bremsstrahlung calculations are discussed. (9 figures, 1 table) (auth)

Weak

Refer also to abstracts 20772 and 20780.

20868 (IFVE-STF-70-107) CALCULATIONS OF π MESON SPECTRA AND PROBABILITY RATIOS OF VARIOUS CHANNELS OF $K \rightarrow 3\pi$ DECAY. Anisovich, V. V.; Volkovitskii, P. E. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1970. 21p. (In Russian). INIS.

The amplitude of the decay $K \rightarrow 3\pi$ includes analytical terms for the energy of the pions and nonanalytical terms connected with the rescattering of the pions. The singular parts of the amplitude of the series $a_l^l(mE)^2$ (where a_l and m are the scattering length and the pion mass and E is the energy released in the decay) were calculated, and expressions for the spectra with the same precision were given. On the assumption that the contribution of the transition with $\Delta I = 7/2$ is small, the expression $R^{+\pm}/4R^{00+} - 3R^{\pm 0}/2R^{000}$ (where R is the total probability of the process) was calculated with precision up to the term of the series $a_l^l(mE)^4$. The restrictions, imposed by the experimental significance of these expressions on the scattering length of the π mesons, were explained. (tr-auth)

20869 (JINR–P2-6865) SOME PHYSICAL CONSEQUENCES IN NONLOCAL QUANTUM THEORY OF WEAK INTERACTIONS. Alebastrov, V. A.; Efimov, G. V.; Seltser, Sh. Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 21p. (In Russian). Dep. NTIS (U. S. Sales Only).

The $\nu-\nu$ interactions and the neutrino electromagnetic form factor are studied in the framework of nonlocal theory of electromagnetic and weak interactions. Two models of weak interactions are considered: the 4-fermion one and that with the W-boson. Some assumptions on the nature of the mass difference of an electron and μ-meson are made. (auth)

20870 FERMION-BASED PARTICLE MODEL. van der Spuy, E. (Atomic Energy Board, Pelindaba, South Africa). pp L.1-23 of Fifth Annual Seminar on Theoretical Physics. Pretoria; Atomic Energy Board (1970).

From 5th annual seminar on theoretical physics; Pretoria, South Africa (13 Jul 1970). See CONF-700728.

It is briefly discussed how a particular non-linear field equation of motion in terms of a fundamental fermion field, relating the four- and two-point functions, may be used as a model showing many of the features of elementary particles. It is suggested that the perturbative solution may conceivably be weakly interacting and will be massless for the γ_5 invariant equation, thus providing a model for leptons. Furthermore, the nonperturbative solution constructed as described previously for a fundamental boson field equation, will be strongly interacting and may provide a model for hadrons. The fundamental infinite component free field derived in the latter carries a tower of fermions on a Regge trajectory. The γ_5 invariance hence does not pertain to the latter solution because it generalizes the equation of motion through the content (essentially that of spin) of the corresponding field. The equation is Lorentz invariant with respect to both solutions and has the correct C, P, T transformation properties. (auth)

20871 QUANTUM THEORY WITHOUT SUPERPOSITION PRINCIPLE. Shapiro, I. S. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 16: No. 6, 1318-1328 (1972). (In Russian).

A formulation of the quantum theory, nonlinear in the state vector was considered in connection with the problem of "missing" $K_L \rightarrow 2\mu$ decays. A possibility of probability interpretation of the wave function and amplitudes was exhibited alongside with the existence of the conserved physical quantities. (auth)

20872 ELECTROMAGNETIC CORRECTIONS FOR WEAK FORM FACTOR OF HADRON. Frankfurt, L. L. (Inst. of Nuclear Physics, Leningrad). Yadern. Fiz.; 16: No. 6, 1260-1269 (1972). (In Russian).

An electromagnetic correction increasing with energy for hadron weak form factor was calculated. The calculations are based on gauge invariance and hypothesis on scaling for the amplitude of deeply inelastic scattering. The final result is valid in a wide group of field-theoretical models. (auth)

20873 DERIVATION OF ADLER, CABIBBO–RADICATTI SUM RULES AND CALCULATION OF ASYMPTOTICS OF CROSS SECTION DIFFERENCE OF NEUTRINO (ANTINEUTRINO) SCATTERING ON POLARIZED HADRONS. Frankfurt, L. L. (Inst. of Nuclear Physics, Leningrad). Yadern. Fiz.; 16: No. 6, 1250-1259 (1972). (In Russian).

It is shown, that Adler, Cabibbo–Radicatti et al. sum rules are valid in a wide group of theoretical-field models in all the orders in the coupling constant and violation of symmetry due to particle mass difference does not change their form. It is also shown, that these sum rules follow from algebra of equal-time current commutators under condition that hypothesis on scaling and on current conservation is valid for the amplitude of deep inelastic scattering. Asymptotic limit for cross-section difference of $\nu,\bar{\nu}$ scattering on polarized hadron was derived. (auth)

20874 $\nu_\mu + N \rightarrow \mu^- + W^+ + N'$ PROCESS AND POSSIBILITIES TO OBSERVE W-BOSON BY KINEMATIC CHARACTERISTICS OF LEPTON IN $W^+ \rightarrow l^+ + \nu_l$ DECAY. Makeev, V. V.; Nevskii, P. L.; Nikitin, Yu. P.; Rozhnov, G. V.; Sokolov, A. A. (Moscow Engineering-Physics Inst.). Yadern. Fiz.; 16: No. 6, 1244-1249(1972). (In Russian).

The investigation was carried out of the angular and energy distributions for l^+-leptons (muons and electrons) produced in the reaction $\nu_\mu + N \rightarrow \mu^- + W^+ + N'$ (N = p,n) with further decay of W-boson in leptonic channel $W^+ \rightarrow l^+ + \nu_l$. It was shown, that narrow peaks in the energy spectra of l^+, emitted at the given angle to neutrino initial momentum in the lab.system are caused by two-particle character of leptonic mode of W-boson decay. A considerable number of events lies in the momentum range and angle of—flight of l^+-leptons, connected with W-boson mass by relation $p_+ \sin \theta_+ \approx m/2$. This effect will allow one to identify W-boson production very reliably, and to determine the values of its mass. Some particular calculations of double differential distributions of l^+ in E_m and $\cos \theta_+$ were carried out with account for neutrino energy spectrum, expected at IHEP, for W mass values m = 3, 4, 5 GeV and total magnetic moment W g = 0, 1, 2. (auth)

20875 WHAT NEUTRINOS CAN TELL US ABOUT PARTONS. Feynman, R. P. (California Inst. of Tech., Pasadena). pp 75-100 of Neutrino '72. Vol. II. Frenkel, A. (ed.). Budapest; OMKDK-Technoinform (1972).

From Symposium on Neutrino 1972; Balatonfuered, Hungary (11 Jun 1972). See CONF-720651-(Vol. 2).

A brief review of the parton idea and its applications to inclusive electron scattering is given. Then applications to inclusive neutrino scattering in the deep inelastic region with final-state hadron distribution are described. The assumptions are consistent with the assumptions of light cone algebra. (JFP)

20876 DEEP-INELASTIC LEPTON–NUCLEON SCATTERING. Kuti, J. (Massachusetts Inst. of Tech., Cambridge). pp 101-128 of Neutrino '72. Vol. II. Frenkel, A. (ed.). Budapest; OMKDK-Technoinform (1972).

From Symposium on Neutrino 1972; Balatonfuered, Hungary (11 Jun 1972). See CONF-720651-(Vol.2).

A review is given of the kinematics of deep inelastic lepton–nucleon scattering, experimental results with comments on sum rules and inequalities, and the probing of partons and light-cone physics in spin-dependent deep-inelastic electroproduction. (JFP)

20877 REPORT ON W BOSON MODEL OF WEAK INTERACTIONS WITH MAXIMAL CP VIOLATION. Marshak, R. E. (City Coll., New York). pp 129-147 of Neutrino '72. Vol. II. Frenkel, A. (ed.). Budapest; OMKDK-Technoinform (1972).

From Symposium on Neutrino 1972; Balatonfuered, Hungary (11 Jun 1972). See CONF-720651-(Vol.2).

A status report is given on the strong cubic W boson model. It is shown how this model can explain the low rate for $K_2 \rightarrow 2\mu$ decay and the high rate for $K_1 \rightarrow 2\mu$. Other experimental tests of this model are summarized such as the $K_2^0 \rightarrow \pi^0 + l + \bar{l}$ and $K^+ \rightarrow \pi^+ + l + \bar{l}$ decay branching ratios. (JFP)

20878 VIRTUAL NEUTRINO EFFECTS. Budini, P. (International Centre for Theoretical Physics, Trieste, Italy). pp 149-161 of Neutrino '72. Vol. II. Frenkel, A. (ed.). Budapest; OMKDK-Technoinform (1972).

From Symposium on Neutrino 1972; Balatonfuered, Hungary (11 Jun 1972). See CONF-720651-(Vol.2).

The production and properties of lepton–antilepton composite states are determined from a hypothesis for the order of the distances for which the modification of the interaction Lagrangian density for lepton weak interactions brings about the modification of the neutrino forces. (JFP)

20879 ANALYTIC RENORMALIZATION AND ELECTRON–ANTINEUTRINO SCATTERING. Horvath, Z.; Pocsik, G. (Roland Eoetvoes Univ., Budapest). pp 175-182 of Neutrino '72. Vol. II. Frenkel, A. (ed.). Budapest; OMKDK Technoinform (1972).

From Symposium on Neutrino 1972; Balatonfuered, Hungary (11 Jun 1972). See CONF-720651-(Vol.2).

A perturbation treatment in the framework of field theory which is valid below the unitarity limit is given. The method introduces a minimum number of unknown parameters. The procedure to be followed is illustrated in second order of the weak interaction and applied to the $\bar{\nu}_e + e$ elastic scattering. The physical amplitude in order G^2 is defined, and the corrections to the cross sections are discussed. (JFP)

20880 APPLICATION OF TWISTOR THEORY IN WEAK INTERACTIONS. Pertes, Z. (Central Research Inst. for Physics, Budapest). pp 183-184 of Neutrino '72. Vol. II. Frenkel, A. (ed.). Budapest; OMKDK-Technoinform (1972).

From Symposium on Neutrino 1972; Balatonfuered, Hungary (11 Jun 1972). See CONF-720651-(Vol.2).

The advantages of the twistor theory for $\bar{\nu} + e \rightarrow \bar{\nu} + e$ interactions are considered. The theory is described, and the cross sections of the studied interaction are found. (JFP)

20881 THEORY OF UNIVERSAL WEAK INTERACTIONS OF LEPTONS. Filippov, A. T. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 185-197 of Neutrino '72. Vol. II. Frenkel, A. (ed.). Budapest; OMKDK Technoinform (1972).

From Symposium on Neutrino 1972; Balatonfuered, Hungary (11 Jun 1972). See CONF-720651-(Vol.2).

A new theory of leptonic weak interactions is described. In this four-fermion theory the universality holds for all leading divergences because of some internal leptonic symmetry, and most dangerous leading divergences can be eliminated by the use of one renormalization constant. (JFP)

20882 MODEL FOR A ONE-KINK METRIC. Williams, J. G.; Zia, R. K. P. (Univ. of Birmingham, Eng.). J. Phys., A (London); 6: No. 1, 1-5(Jan 1973).

It is well known that the metric tensor of general relativity may be associated with a conserved quantity, which is an integer known as the "kink number." A model is introduced for a metric corresponding to a single stationary kink centered at the origin. The Christoffel symbols and the energy–momentum tensor are deduced, and by investigating the asymptotic properties of the mass density, an inverse square law is seen to arise. (auth)

Strong (General)

Refer also to abstracts 20759 and 20786.

20883 (JINR–P2-6762) AUTOMODALITY IN INCLUSIVE REACTIONS. Muradyan, R. M. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1972. 111p. (In Russian). Dep. NTIS (U. S. Sales Only).

A review of experimental data on many-body hadronic interactions at high energies is presented, and their theoretical interpretation is given in terms of current theoretical ideas of Yang, Feynman, Muller and automodelity hypothesis in strong interactions. (auth)

20884 (SGAE-2035) ROLE OF UNITARITY AND CROSSING IN STRONG INTERACTION MODELS. Urban, P. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Physik-Institut). Sep 1972. 19p. (In German). Dep. NTIS (U. S. Sales Only).

The properties of the scattering matrix such as unitarity and analyticity were considered in order to explain the dispersion relation. Some indications on the theoretical contribution to $\Pi\Pi$ were given in conclusion. (JSR)

20885 MULTIPLE SCATTERING THEORIES AT HIGH ENERGIES. Butterworth, D. S. (Univ. of Cape Town). pp G.1-34 of Fifth Annual Seminar on Theoretical Physics. Pretoria; Atomic Energy Board (1970).

From 5th annual seminar on theoretical physics; Pretoria, South Africa (13 Jul 1970). See CONF-700728.

The Glauber theory for multiple scattering is considered for strong interactions although what the hadron subunit may be is nuclear. Glauber theory, the Chou–Yang model, elastic scattering of composite particles, Regge eikonal models, and model extension to inelastic processes are covered. (JFP)

20886 FIXED POLES, UNITARITY, AND DUALITY. Capella, A. (Paris Univ., Orsay, France). pp 361-367 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333–(Vol.1).

The aim of this work was to provide evidence in favor of the existence of some right signature nonsense fixed poles in hadron reactions. It is shown that, in some cases, unitarity is not contradictory with the presence of fixed poles but, on the contrary, makes them to propagate from one reaction to another. (France)

20887 SOME PROPERTIES OF A DUAL POLE–POLE MODEL. THE C.T.H.K.Z. MODEL. Hong Taun, R. (Paris Univ., Orsay, France). pp 391-399 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333–(Vol.1).

The Cohen–Tannoudji model (C.T.H.K.Z. model) is compared with the Veneziano model. Explicit crossing symmetry and pole-pole duality are the first two principles which led to the model. Non-zero width resonances can be introduced without producing ancestors; the M(s,t) amplitude has the unitary thresholds at $s = s_0 = 4\mu^2$ and $t = t_0 = 4\mu^2$, it has also a double spectral function (with correct boundary) and a Regge-like behavior on the real s axis. The model is in a condensed form and makes computer calculations easy. Unitarization is to be completed in a crossing symmetric way. (France)

20888 TESTS OF THE EQUAL-PHASE ASSUMPTION IN DOUBLE RESONANCE PRODUCTION. Plaut, G. (Univ., Nice). pp 431-437 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333–(Vol.1).

Tests for determining whether the amplitudes in a given resonance production reaction are in-phase or out-of-phase are presented (without the calculations). The test consists of $(2J + 1)^2$ constraints that must be verified if the amplitudes are in phase. (France)

20889 STATISTICAL BOOTSTRAP MODEL AND ERICSON FLUCTUATIONS. Frautschi, S. (European Organization for Nuclear Research, Geneva). pp 1-35 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333–(Vol.2).

The possible extensions of the statistical models in hadron physics are examined. The statistical bootstrap model for the hadron level density is described in detail. Using nuclear analogy the idea of Ericson fluctuations is applied in testing hadron statistical models. (France)

20890 DUAL-AMPLITUDE ANALYSIS OF INCLUSIVE DISTRIBUTIONS. Kang, K. (Brown Univ., Providence). pp 61-73 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333–(Vol. 2).

Methods used for the dual-amplitude analysis of the inclusive distributions at high energies are discussed. The dual-amplitude analysis is shown to predict the cutoff experimentally observed in transverse momenta, vanishing of the triple Regge vertex for the integral values of the trajectory intercepts, and the nature of the short-range correlation. (France)

20891 RESONANCE DECAYS IN INCLUSIVE REACTIONS. Roberts, R. G. (Science Research Council, Chilton, Eng.). pp 121-139 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333–(Vol.2).

In the inclusive approach, a summation over all final states simplifies a seemingly complicated situation, but certain final states are expected to be relatively more important than their competitors. Kugler has shown that bounds can be obtained on the relevant Regge trajectories when particular exclusive processes are chosen. The Kugler approach is reviewed for the case of two-body decays of resonances and an extension for many-body decays is envisaged. (France)

20892 EXPERIMENTAL ASPECTS OF CORRELATIONS IN INCLUSIVE EXPERIMENTS. Peccei, R. D. (Stanford Univ., CA). pp 227-241 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.2).

Three classes of models quantifying the nature of correlations in inclusive reactions are discussed: the weakly correlated models (the multiperipheral model, the dual resonance model, the Feynman gas and the Mueller–Regge model with a factorizable Pomeranchuk singularity), the diffractive weakly correlated models, and the diffractive excitation models. (France)

20893 DIFFRACTIVE DISSOCIATION OF π, K, AND P IN TWO-BODY OR QUASI-TWO-BODY. Spiro, M. (CEN de Saclay, Gif sur-Yvette, France). pp 341-360 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.1).

The diffractive dissociation of a particle A refers to the following process $A + B \rightarrow X + B$. Only the X diffractive systems decaying into two particles or resonances are examined. The reggeized Deck model (double Regge pole model) succeeds to reproduce the main properties of the diffractive bumps. This could suggest that the two interpretations (Deck effect and resonances) are just the expression of duality: for instance reggeizing the π, gives for low ρ pion or $K^*\pi$ masses some strong enhancements which would appear as the average of true resonances. (France)

20894 APPLICATION OF THE STATISTICAL MECHANICS METHODS IN DUAL MODEL. Demchenko, G. P.; Kukhtin, V. V.; Struminskii, B. V. (Inst. of Theoretical Physics, Kiev). Yadern. Fiz.; 16: No. 5, 926-930(1972). (In Russian).

The distribution function for resonance spins and the dependence on mass for the elastic widths of resonances are obtained by the statistical mechanics methods using the factorization of tree dual amplitudes with a finite number of oscillators. (auth)

20895 TWO-COMPONENT DESCRIPTION FOR THE PRODUCTION OF HADRONIC MULTIPARTICLE FINAL STATES. Harari, H.; Rabinovici, E. (Weizmann Inst. of Science, Rehovot, Israel). Phys. Lett.; 43B: No. 1, 49-52(8 Jan 1973).

Production amplitudes of hadronic multiparticle final states are assumed to include a diffractive, energy independent component and a nondiffractive component of a general multiperipheral nature. All data above $P_{lab} = 50$ GeV/c are well fitted by such a model, and predictions for higher energies are made. (auth)

20896 MULTIPLICITY DISTRIBUTION AND PRODUCTION MECHANISMS IN HIGH ENERGY HADRON COLLISIONS. Van Hove, L. (CERN, Geneva). Phys. Lett.; 43B: No. 1, 65-67 (8 Jan 1973).

Wroblewski has noted that, in inelastic hadron collisions at high energy, the average charged multiplicity, $\langle n \rangle$, and the dispersion, $D (= (\langle n^2 \rangle - \langle n \rangle^2)^{1/2})$, obey a linear law $D = A\langle n \rangle - B$ with A,B constant. It is shown that such a linear relation is easily understood if there are two distinct classes of inelastic collisions, each having approximately constant cross section and reasonably small dispersion, but one having markedly larger multiplicities than the other. The low-multiplicity class, naturally identified with diffraction dissociation, is found to have a cross section about equal to the elastic cross section, for both pp and πp collisions. (auth)

20897 SEMI-CLASSICAL ABSORPTION MODEL FOR THE MULTIPLICITY MOMENTS. Nielsen, H. B.; Olesen, P. (Univ. of Copenhagen). Phys. Lett.; 43B: No. 1, 37-40(8 Jan 1973).

A simple semi-classical absorption model in which the particles produced in a hadronic collision are created in bunches is used to estimate the moments of the multiplicity distribution. By using an eikonal approximation, an estimate of the average number of bunches per collision is made from the ratio $\sigma_{el}/\sigma_{inel}$. One prediction is $\langle n \rangle / D \approx 2$, in very good agreement with experiment. This result is not very sensitive to $\sigma_{el}/\sigma_{inel}$. Scaling of the multiplicity distribution becomes a consequence of $\sigma_{el}/\sigma_{inel} \approx$ const. The onset of early scaling in multiplicity then becomes related to the constancy of $\sigma_{el}/\sigma_{inel}$. (auth)

20898 DUAL RESONANCE MODEL AND STATISTICAL BOOTSTRAP. Miranskii, V. A.; Shelest, V. P.; Struminskii, B. V.; Zinov'ev, G. M. (Inst. for Theoretical Physics, Kiev). Phys. Lett.; 43B: No. 1, 73-75(8 Jan 1973).

The statistical approach to dual resonance models is used to investigate the mechanism for heavy resonance decay. The results obtained suggest that the dual resonance models are a dynamic realization of the statistical bootstrap theory of hadrons. (auth)

20899 MONTE CARLO CALCULATION OF HADRONIC CASCADES AT HIGH ENERGY. Ranft, J. (Karl-Marx-Univ., Leipzig). Comput. Phys. Commun.; 4: No. 1, 59-63(Oct 1972).

The transport of particles and the transport and deposition of energy in matter by the hadronic cascade is calculated by a Monte Carlo method. The most important input data are absorption cross sections of high energy particles on nuclei and inclusive single particle production cross sections as well as other data related to the interactions of high energy particles with matter. We describe the method used to select random events which satisfy both the inclusive cross sections and energy conservation in each event. This method differs from the usual methods for sampling according to phase space, which are not applicable here. We discuss also the general structure of the Monte Carlo programs. Such procedures are applied to calculate: shielding requirements, induced radioactivity, direct radiation doses and radiation heating around high energy accelerators; the performance of total absorption detectors for hadrons, and the modification of secondary particle production in targets due to the hadronic cascade in the target. (auth)

Strong (Baryon No. = 0)

20900 (JINR-P1-6853) SEARCH FOR STRUCTURAL EFFECTS IN CAPTURE OF π^- MESONS BY HYDROGEN OF COMPOUND MOLECULES. Krumshtein, Z. V.; Petrukhin, V. I.; Risin, V. E.; Smirnova, L. M.; Suvorov, V. M.; Yutlandov, I. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 7p. (In Russian). Dep. NTIS (U. S. Sales Only).

The effect of molecular structure on the probability of negative pion capture by bound hydrogen has been investigated. For aliphatic hydrocarbons, the capture probability was shown to be independent of the length and spatial structure of the carbon chain. For benzene hydrocarbons, this probability was found to be lower, which appears to be due to the modification of orbital hybridization. The identical group effect was observed only for the inorganic bases. (auth)

20901 (NP–19633) PION–PION SCATTERING: USE OF CROSSING, ANALYTICITY AND POSITIVITY. Grassberger, Peter (Bonn Univ. (West Germany). Physikalisches Institut). Nov 1972. 84p. (In German). (PIB–128). Dep. NTIS (U. S. Sales Only).

Crossing, analyticity, and positivity were used in the calculation of pion-pion scattering. First simple sum rules for the partial waves in the nonphysical range, which all result from the crossing symmetry, were given. The principal results are sum rules for the imaginary part of the partial wave in the physical range, which result from crossing analyticity. Inequalities for scattering amplitudes in the physical range were first derived and then sharper inequalities in the nonphysical range. A brief review is given of low-energy models and integral equations which can be used in their construction. (tr-auth)

20902 POSITIVITY AND CROSSING CONSTRAINTS ON $\pi\pi$ PARTIAL WAVE AMPLITUDES. Yen, H. C. New Haven; Yale Univ. (1972). 96p. University Microfilms Order No. 73-808.

Thesis (Ph. D).

On the basis of unitarity, analyticity and crossing symmetry, we study rigorous constraints on the $\pi\pi$ partial wave amplitudes. In particular, we derive several new constraints on the $\pi^0\pi^0$ partial waves. First we prove that the slope of the $\pi^0\pi^0$ d-wave amplitude $f_2(s)$ is negative for $1.557\ m_\pi^2 < s < 4m_\pi^2$. Then we derive some positivity constraints on the parameters appearing in Roskies' crossing symmetric parametrization of the $\pi^0\pi^0$ partial wave amplitudes below threshold. These constraints are then translated into restrictions on the $\pi^0\pi^0$ s-wave alone, and hence are used to analyze existing models for low energy $\pi\pi$ scattering. We show that none of the models that we have examined satisfies all our constraints. We also derive sufficient conditions which indicate that our results cannot be improved very much. Finally, we show how the knowledge of the s-wave below threshold can give us useful information about the physical partial waves above threshold. (Diss. Abstr. Int., B)

20903 TOWARDS AN AMPLITUDE ANALYSIS OF $\pi^+\pi^-$ PRODUCTION DATA AT 15 GeV/c. Froggatt, C. D. (European Organization for Nuclear Research, Geneva). pp 299-319 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.1).

A model amplitude analysis of 15 GeV/c data on the process $\pi^-p \to \pi^+\pi^-n$ is presented at small momentum transfers to the nucleon and for the dipion mass $M(\pi\pi)$ in the ρ band ($0.665 < M(\pi\pi) < 0.865$ GeV). Spin (nucleon) and phase coherence are assumed for the unnatural parity exchange component of the production amplitudes. The t channel amplitudes obtained by time dependent (TDAA) or time independent amplitudes analysis (TIDAA) are both given. The constraints appear to be adequately satisfied. Examples of s channel amplitudes, fits to the differential cross section, and fits to density matrix elements in both the t and s channels are given. With TDAA results, the over-all magnitude is satisfactory and the ratio of S to P wave production via OPE agrees with the expected values. (France)

20904 COMPATIBILITY BETWEEN CURRENT ALGEBRA AND UNITARITY IN πK SCATTERING. Ader, J. P. (Bordeaux Univ., Talence, France). pp 321-339 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.1).

A parametrization of the Iliapoulos type is considered. The amplitudes are assumed to satisfy the following conditions: exact crossing symmetry, correct threshold behavior of partial waves, ability for a particle to go off mass-shell and agreement with Mandelstam analyticity on and off-shell. Selected solutions, in the π^- extrapolation approach, are shown to be in agreement with the Adler condition, give a reasonable value of the Weinberg length and conveniently satisfy unitarity and positivity. (France)

20905 RESOLUTION OF THE QUESTION OF $\pi\pi$ AND Kπ ANOMALIES. Eguchi, T.; Fukugita, M.; Shimada, T. (Tokyo Univ.). Phys. Lett.; 43B: No. 1, 56-60(8 Jan 1973).

The question of anomalies in the harmonic moments is resolved by means of considerations on the interplay between harmonic moments and amplitude zeros in $\pi\pi$ and Kπ scattering. The systematics of $\pi\pi$ amplitude zeros is also shown to be in qualitative agreement with the hypothesis of the existence of the double-pole-killing dual zeros. (auth)

Strong (Baryon No. = 1)

Refer also to abstracts 20976 and 21224.

20906 (IFVE-ORZ-71-96) INVESTIGATION INTO NUCLEON-MESON CASCADE IN SHIELDING MEDIA. Endovitskii, V. S.; Kumel, L. P.; Mokhov, N. V.; Britvich, G. I.; Lebedev, V. N. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 25p. (In Russian). INIS.

An investigation of the characteristics of the field of cascade particles, initiated by a cluster of high-energy hadrons in shielding material, was made. With use of the individual resolution of the problem of the transport of cascade particles, obtained in approximation of the small angle of the hadrons on the nuclei, the distribution functions with respect to the angle and energy of the nucleons and ions were found as a solution of the system of cascade equations. The partial functions of the spatial-energy distribution were determined and the effective algorithm of their numerical calculation was described. The measurement of the integral functions of the attenuation of the current of cascade particles and the dosimetric characteristics of the irradiation field were reported. Experimental data were compared with calculated data. The good agreement of the experimental and calculated data indicates the possibility of the solution with the help of the suggested calculation methods of the majority of the practical problems of the shields of high-energy accelerators just as with the Monte-Carlo method. However the developed algorithm for the calculation of the spectral and spatial characteristics of the cascade particles shows to a significant degree greater efffectiveness with respect to the machine time than the Monte Carlo method. (tr-auth)

20907 (JINR-P2-6871) $\pi^-p \to nl^+l^-$ PROCESS NEAR THE $\Delta(1236)$ RESONANCE. Smirnov, G. I.; Shumeiko, N. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 19p. (In Russian). Dep. NTIS (U. S. Sales Only).

The process $\pi^-p \to nl^+l^-$ near the $\Delta(1236)$ resonance is treated using the isobaric model. It is shown that the isobar term gives small contribution to the cross section. The sensitivity of the cross sections to the electromagnetic structure of pion and nucleon is investigated. The results of computation are compared to experimental data. (auth)

20908 (RPP/T-23) SHACKLES ON LINEAR ABSORPTION MODELS. Barger, V.; Phillips, R. J. N. (Rutherford High Energy Lab., Chilton (England)). 1972. 17p. Dep. NTIS (U. S. Sales Only).

We examine the fundamental constraints that all linear absorption models (LAM) must possess, independent of the rescattering amplitude. These constraints are most direct in impact parameter space, where the re-scattering appears simply as a multiplicative factor. It is a crucial test of such models that the ratio of two exchanges—for example vector and tensor exchanges—is completely specified in b-space by the ratio of input Regge pole amplitudes. Amplitude analyses exist for vector ρ exchange, in $\pi^-p \to \pi^0n$. Lacking experimental A_2 tensor amplitudes, we use the LAM constraint to calculate A_2 exchange from ρ input, and compare the results with $\pi^-p \to \eta^0n$ data. Both simplicity and duality assumptions for Regge pole couplings are considered. The results suggest that the LAM constraint is not fully consistent with data. (auth)

20909 REGGE BEHAVIOR AND DAUGHTER DEGENERACIES IN FOURTH-ORDER SPINOR-VECTOR SCATTERING. Prum, S. Los Angeles; Univ. of California (1972). 162p. University Microfilms Order No. 72-33,972.

Thesis (Ph.D).

For the scattering of spin $\frac{1}{2}$ nucleons and neutral vector mesons, perturbation theory is used to study the analytic properties of the electron and associated Regge trajectories. A discussion of several useful techniques for the evaluation of asymptotic integrals with spin numerators is presented, and the results are used to determine the nonpolynomial form of the fourth-order spinor-vector scattering amplitude at $s = 0$. It has been previously shown by Abers, Cassandro, Teplitz and Muzinich, that infinite sequences of daughter trajectories conspire with the electron trajectory to satisfy the kinematic constraints at $s = 0$. It is found that the residues of these daughters do not factor in second-order perturbation theory, where a threefold degeneracy appears to be present; in fourth-order, sufficient information exists to resolve the degeneracy and show factorization. The nonpolynomial asymptotic expansion (to all orders in t) for the helicity-dependent scattering amplitude in fourth-order perturbation theory is calculated for the t and u physical channels. Crossing relations are used to reconstruct the s-channel amplitudes which are then expressed as parity-conserving signatured amplitudes. Difficulties encountered by Keller in canceling the $(\log t)^2$ contributions that come from individual diagrams are resolved, and the leading term is found to be in agreement with the value previously obtained by Gell-Mann, Goldberger, Low, Marx and Zachariasen. An analysis of the next-to-leading order terms in the amplitude finds that the first daughter trajectories separate in fourth-order perturbation theory and there appear to be at least four daughters passing through $J = -\frac{1}{2}$. An additional feature of the fourth-order amplitude is the presence of next-to-leading order terms of the form $t^{-1}(\log t)^2$, which point to the existence of fixed poles of order three at the negative half-integer values of J. (Diss. Abstr. Int., B)

20910 CROSS-OVER EFFECT IN INELASTIC REACTIONS. Leith, D.W.G.S. (Stanford Linear Accelerator Center, CA). pp 31-52 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.1).

Results obtained for the inelastic diffractive processes $K^0p \to Q^0p$ and $\bar{K}^0p \to \bar{Q}^0p$ in the (1-12) GeV/c momentum region are discussed. A cross-over effect occurs in the differential cross section for particle and antiparticle processes appearing in the inelastic Q production, just as in elastic scattering. The analysis of the differential cross sections shows that these reactions, thought to be dominated by Pomeron exchange, have also important Regge contributions. (auth)

20911 $K^0_{l,s}p$ INTERACTIONS AND EXCHANGE DEGENERACY. Leith, D.W.G.S. (Stanford Linear Accelerator Center, CA). pp 53-82 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.1).

About 800,000 pictures of a SLAC $K^0_{l,s}p$ experiment were analyzed (1-12 GeV/c). For simple cases, where the two exchanges (ρ,A_2) or (K^*, K^{**}) are dominant, there are some indications that a weak exchange degeneracy (EXD) may work in the energy region 10-15

GeV/c. The slopes of the differential cross sections are becoming equal to even lower energies, but the cross sections are generally not in good agreement below 10 GeV/c, although they show trends which could bring equality by, say 15 GeV/c. So, a somewhat limited success in the energy region studied is obtained, deviations by a factor of two being rather common. (France)

20912 AMPLITUDES FOR CHARGE AND HYPERCHARGE EXCHANGE REACTIONS. Martin, A. D. (European Organization for Nuclear Research, Geneva). pp 83-97 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.1).

The amplitudes for πN scattering at 6 GeV/c are analyzed from recent measurements of R^- and P^0 (where superscripts $\pm$, 0 refer to $\pi^+p \to \pi^+p$, $\pi^-p \to \pi^0n$ respectively). The over-all picture emerging for vector and tensor exchanges in spin 0-spin $\frac{1}{2}$ scattering is that the s channel helicity flip and also the real parts of the non-flip amplitudes show Regge pole like behavior, whereas the imaginary parts of the non-flip amplitudes are modified. The various absorption prescriptions are unable to give an adequate description of the data. (France)

20913 POLARIZATION MEASUREMENTS IN πp CHARGE EXCHANGE USING A NEW TECHNIQUE, AND CONCLUSION OF $\pi^\pm$p POLARIZATION IN ALL ANGLES AT THE INTERMEDIATE ENERGIES. Yokosawa, A. (Argonne National Lab., IL). pp 99-112 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.1).

All the existing charge-exchange polarization measurements in πp scattering processes are reviewed and different methods used in various experiments are discussed. Results from new measurements of polarization in $\pi^\pm$p elastic scattering, from 1.60 to 2.30 GeV/c, are presented. The t-exchange effect is shown, particularly in 2.30 GeV/c data, from the forward region all the way to the backward region. (France)

20914 HYPERCHARGE EXCHANGE REACTIONS AT 4 GeV/c. Videau, H. (Ecole Polytechnique, Paris). pp 153-171 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.) Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.1).

The main features of the K^-p and π^-p hypercharge exchange reactions at 4 GeV/c are analyzed. The forward and backward total cross sections and differential cross sections are given. In $K^*(1400)$, f* and f meson production the only respective $K\pi$, $K\bar{K}$ and $\pi\pi$ decay modes are taken into account. Both natural parity exchange and unnatural parity exchange distributions are studied. SU(3) is introduced in the exchange mechanism. The baryon vertex is analyzed in view of determining the F/D ratios for the vector-tensor exchange. (France)

20915 SIMPLE RELATIONS AMONG EXCHANGE REACTIONS FROM GENERAL PRINCIPLES. Dar, A. (Massachusetts Inst. of Tech., Cambridge). pp 173-206 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.1).

Only exchange reactions that lead to final states with two body or quasi two body are considered (no zero-quantum numbers other than spin and parity are exchanged in the t-channel). The general principles of maximum analyticity, crossing symmetry, finite energy sum rules, SU(3) symmetry and a general assumption about the asymptotic behavior of scattering amplitudes are shown to yield simple relations among the final states. All reactions of the type $0_8^- + \frac{1}{2}_8^- \to 0_8^- + \frac{1}{2}_8^-$ can be directly predicted from a single measured reaction of the same type (e.g., $\pi^-p \to \pi^0n$) where a particle is represented by its spin and parity, using the convenient SU(3) representation. All reactions of the type $0_8^- + \frac{1}{2}_8^+ \to 0_8^- + \frac{3}{2}_8^+$ can be directly predicted from a single measured reaction of the same type, say $\pi^+p \to \pi^0\Delta^{++}$. (France)

20916 ABSORPTION EFFECTS IN CHARGE AND HYPERCHARGE EXCHANGE REACTIONS. Sadoulet, B. (European Organization for Nuclear Research, Geneva). pp 207-232 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.1).

A phenomenological interpretation is presented for the following charge and hypercharge exchange reactions: $\pi^-p \to \pi^0n$, $\pi^-p \to \eta n$, $K^-p \to \bar{K}^0n$, $K^+n \to K^0p$, $\pi^-p \to K^0\Lambda$, $K^-p \to \pi^0\Lambda$, $\pi^+p \to K^+\Sigma^+$, $K^-p \to \pi^-\Sigma^+$ and $\bar{p}p \to \bar{\Lambda}\Lambda$, $\bar{\Lambda}\Sigma^0$ + charge conjugated, $\bar{\Sigma}^+\Sigma^+$ in the region of 5 GeV/c incident momentum. It is shown that deviations from exchange degeneracy may be due essentially to absorption effects. A trial in view of determining their characteristics from the data is presented. (France)

20917 MODIFICATIONS OF REGGE CUT CALCULATIONS. Hogaasen, H. (Paris Univ., Orsay, France). pp 233-247 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.1).

Absorptive Regge cuts ran into difficulties when the polarization in πN charge exchange was measured at relatively high momentum transfer. Two possibilities are examined; the pomeron has more structure than has been used, or the way cuts are calculated should be changed. The logical possibilities of changing the cut calculations away from the absorption model are examined inside the Reggeon calculus of Gribov. (France)

20918 πN HIGH ENERGY SCATTERING AMPLITUDES AND DATA. Kane, G. L. (Science Research Council, Chilton, Eng.). pp 249-261 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.1).

A model which incorporates a phase into the elastic πN scattering amplitude is described. The rho exchange is absorbed using an absorbing amplitude enhanced in magnitude, and with the elastic phase. The latter is determined internally to describe all the information about πN scattering. (France)

20919 AMPLITUDE ANALYSIS FROM DECAY CORRELATIONS. Martin, A. D. (European Organization for Nuclear Research, Geneva). pp 439-457 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.1).

It is shown that the observation of the decay correlations in a reaction of the type $K^-p \to VY$ or $\pi^-p \to K^*Y$ with V = ρ, ω or ϕ and Y = Λ or Σ^+, can be used to determine the six independent production amplitudes, apart from two phase factors. An amplitude analysis for $\pi^-p \to K^*\Lambda$ using data at 3.9 GeV/c is discussed. A model independent determination of the amplitudes for $\pi^-p \to K^*\Lambda$ at 3.9 GeV/c is also presented. (France)

20920 SPECTRUM SYMMETRY OF PION LONGITUDINAL MOMENTA IN SEMI-INCLUSIVE π^-p^- INTERACTIONS AT P = 4 GeV/c. Grishin, V. G.; Inogamov, Sh. V.; Yuldashev, B. S.; Yancho, G. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 5, 1114-1116(1972). (In Russian).

It was shown, that in $\pi^-p \to \pi + \ldots$ reaction at p_π = 4 GeV/c the spectrum of pion longitudinal momenta has symmetry in the coordinate system where $R = |p_b|p_\pi| = 1.69 \pm 0.15$. Possible interpretation of this effect is given. (auth)

20921 PRODUCTION OF LEPTONIC PAIRS IN INTERACTION OF π-MESONS WITH NUCLEONS. Kulish, Yu. V. (Physical Technical Inst., Kharkov). Yadern. Fiz.; 16: No. 5, 1102-1113 (1972). (In Russian).

Production of a leptonic pair and $\frac{1}{2}^+$ baryon in collision of pseudoscalar meson with polarized nucleon PN $\to$ Bll was considered. T-invariance allows to connect the amplitudes of these processes with those of lB $\to$ lNP. The reactions $\pi^-p \to ne^+e^-$ and $\pi^+n \to pe^+e^-$ were treated at 3-momentum of π-meson, equal to zero (in current algebra approach) in N*(1236) and N*(1700) resonance region, as well as at high energies s and small transferred momenta t. It is noted, that at $k^2 \to -(W-m)^2$ the contributions with $J^P = \frac{1}{2}^-$ and $\frac{3}{2}^-$ dominate in the cross section. The experiment performed with a polarized target at $s \gg |t|$ may turn out to be very effective in determining a relative phase of formfactors F_π and F_1^V. (auth)

20922 RESCATTERING EFFECTS IN pd $\to$ ppn REACTION. Golovin, B. M.; Lykasov, G. I.; Rozanova, A. M.; Tarasov, A. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 5, 1096-1101(1972). (In Russian).

Calculations of differential cross section for pd $\to$ ppn scattering at T_p = 600 MeV are being carried out in symmetric geometry in momentum approximation. Account for double scattering of an incident particle on deuteron nucleons as well as for spin structure

of NN-amplitudes allows one to give a satisfactory description of the experimental data available. (auth)

20923 ELECTROMAGNETIC EFFECTS IN POLARIZATION IN MESON–NUCLEON SCATTERING. Vanzha, A. P.; Lapidus, L. I.; Tarasov, A. V. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 5, 1023-1034(1972). (In Russian).

Attention is drawn to the fact, that at high energies in elastic (and some inelastic) collisions account for strong interactions as well as electromagnetic one of spin particles considerably influences hadron polarization at small t. Study on P_0, R and A parameters at small t allows one to define imaginary and real parts of hadron A and B amplitudes. (auth)

20924 INCLUSIVE PRODUCTION OF PARTICLES AND ANTIPARTICLES IN SPECTRUM CENTRAL REGION AND RESONANCE πN-SCATTERING. Gendenshtein, L. E.; Kaidalov, A. B. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 16: No. 6, 1307-1313(1972). (In Russian).

Inclusive single-particle spectra of particles and antiparticles were considered in the central region at $x \to 0$. It is shown, that in spite of the fact that at super–high energies they should be similar, they may considerably differ at the available energies ($E \sim 10$ to 10^3 GeV) owing to elastic and inelastic scattering in the upper and lower blocks of multiperipheral diagram. A transition to asymptotic equality of spectra was studied. In the multiperipheral model proton and pion spectra were calculated and their main properties were considered. (auth)

20925 CONTINUOUS-MOMENTUM SUM RULES AND ASYMPTOTIC OF TOTAL CROSS SECTIONS OF πN-INTERACTION. Babaev, Z. R.; Zamiralov, V. S. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 16: No. 6, 1302-1306(1972). (In Russian).

Proceeding from the latest experimental data on total cross sections of πN-interaction different cases of asymptotic behavior for amplitude of π-meson charge exchange on nucleon is analyzed with the help of continuous-momentum sum rules. The results of analysis show that the best agreement with experiment may be obtained assuming the existence of finite difference between the total cross sections of $\pi^{\pm}$N-interaction at high energies. The difference value is of the order of 0.5 mbrn. (auth)

20926 QUASITHRESHOLD BEHAVIOR OF THE AMPLITUDE OF $\pi + N \to N + (\gamma\text{-VIRTUAL})$. Surovtsev, Yu. S.; Tkebuchava, F. G. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 6, 1294-1296(1972). (In Russian).

It is shown, that at small values of the momentum of virtual photon the cross section for $\pi + N \to N + (\gamma\text{-virtual})$ is mainly determined by the Born terms of the amplitude. Thus, the description of process becomes almost model independent, when virtual photon "mass" tends to its maximum value at the fixed total energy. (auth)

20927 MODEL OF PARTIAL-WAVE ANALYSIS OF $\pi N \to \pi\pi N$ REACTIONS NEAR THE THRESHOLD OF Δ_{1236} RESONANCE PRODUCTION WITH ACCOUNT OF TRIANGULAR DIAGRAM CONTRIBUTION. Bunyatov, S. A.; Kurbatov, V. S.; Likhoded, A. K. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 6, 1279-1285(1972). (In Russian).

A model is considered that allows the phenomenological analysis of all the five channels of $\pi N \to \pi\pi N$ reaction from the threshold up to 500 MeV to be performed. Description of all the reaction channels in particular in close vicinity of the production threshold of Δ_{1236}-isobar in the energy interval 350 to 450 MeV requires an account for Δ_{1236}-isobar and $\sigma(750)$ meson in the final state as well as for the contribution of the triangle diagram. Account for the triangle diagram makes estimation of $\pi\pi$-scattering length possible. (auth)

20928 ESTIMATION OF $\pi\pi$-SCATTERING LENGTH α_0 THROUGH METHOD OF SELECTING THE CONTRIBUTION OF TRIANGULAR DIAGRAM IN REACTIONS $\pi N \to \pi\pi N$. Bunyatov, S. A. (Joint Inst. for Nuclear Research, Dubna, USSR); Kurbatov, V. S.; Likhoded, A. K.; Shtaudenmaier, G. M. Yadern. Fiz.; 16: No. 6, 1286-1293(1972). (In Russian).

The results of partial-wave analysis of five channels of $\pi N \to \pi\pi N$ reaction at 430 MeV beam energy with account for the contribution of triangular diagram are presented. In the framework of the considered model it is shown that an account for triangular diagram contribution is necessary for joint description of all the five channels of $\pi N \to \pi\pi N$ reaction. Three solutions that provide coinciding values for $\pi\pi$-scattering length α_0 were obtained, thus one can uniquely determine the sign and quantity α_0 being equal to $(0.65 \pm 0.16)\lambda_\pi$. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 21229 and 21230.

20929 (COO–3130-TA-274) ELASTIC WIDE-ANGLE HADRONIC SCATTERING. Fried, H. M.; Kirby, B.; Gaisser, T. K., (Brown Univ., Providence, R. I. Dept. of Physics; Bartol Research Foundation, Swarthmore, Pa.). 1972. 11p. Dep. NTIS.

The most recent ISR elastic pp data is compared with predictions of the SVNVM (gluon) model. The model is used to examine and predict qualitative features of high energy pp, πp, $p\bar{p}$ elastic, $\gamma p \to \pi^+ n$, and $F_\pi(t)$ at very large momentum transfers. (auth)

20930 (HU-TFT-72-22) THREE-BODY CALCULATION FOR POLARIZATION EFFECTS IN THE NEUTRON–DEUTERON SCATTERING. Doleschall, P. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). Sep 1972. 57p.

The Faddeev equations with separable two-particle interactions have been solved for the 2n + p system at energies 14.1 and 22.7 MeV respectively. The simultaneous and single effect of the S-, P-wave interactions and tensor force on the differential cross section and polarizations has been studied. The experimental data have not been reproduced satisfactorily. A method different from the contour deformation method has been suggested to treat the singularities of the kernels of the Faddeev integral equations. (auth)

20931 (JINR-P2-6891) ANALYTICITY AND THE DIFFRACTION SLOPE OF THE pp-ELASTIC SCATTERING. Dumbrais, O. V.; Chernev, Kh. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 8p. (In Russian). Dep. NTIS (U. S. Sales Only).

A model-independent method of analyzing experimental data on the pp-scattering is used to investigate the slope parameter of the diffraction peak in elastic scattering. The method exploits the known analyticity properties of the scattering amplitude and experimental data in a limited angular range. The analysis suggests that the diffraction slope continuously increases with decreasing $|t|$ in the very forward direction. (auth)

20932 LEADING PARTICLE AND ASYMMETRY OF THE NEUTRAL ρ^0 MESON DECAY IN THE REACTION $\pi^- + A \to 2\pi^-\pi^+ + A^*$. Protasov, V. P.; Sergeev, F. M. (Moscow Inst. of Engineering Physics). JETP Lett. (USSR) (Engl. Transl.); 16: No. 9, 377-379(5 Nov 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 9, 531-534(5 Nov 1972).

The mechanism that causes the asymmetry of ρ^0 decay in the reaction $(\pi^-, 2\pi^-\pi^+)$ on nuclei is discussed. This asymmetry is found to be the consequence of the general kinematic properties of reactions that lead to the formation of the leader (a group of particles having the same sign as the primary particle and retaining its direction and momentum). (JFP)

20933 POLARIZATION EFFECTS IN THE REACTION $pp \to pN^*$ at 14 GeV/c. Valdata, M. (Univ., Pisa, Italy). pp 113-127 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.1).

A detailed study of the two charged prong events originated by protons hitting a polarized target has shown evidence of polarization effects in the reaction $pp \to pN^*$. (France)

20934 X AND p^2(TRANSVERSE) DISTRIBUTIONS OF INCLUSIVE REACTIONS IN THE FRAGMENTATION REGION. Salin, P. (Bordeaux Univ., Talence, France). pp 99-120 of Proceedings of the 7th Rencontre de Moriond. Vol. 2. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.2).

The shape of inclusive distributions in the fragmentation region is studied as a function of $x = 2q$ (longitudinal)$/\sqrt{s}$, using a basic Regge phenomenology. It is dominated by three effects: the kinematic relationship between the Mandelstam variables t and M^2 and the c.m. variables x and p^2 (transverse); the dynamics due to the intercept of the leading trajectory exchange in the t (or u) channel; the presence of an exponential factor in x. The p^2 (transverse) dependence is quantitatively studied and a simple parametrization is obtained for all $pp \to \pi^{\pm}$ + anything data. (France)

20935 SLOW π-MESON PRODUCTION IN INTERACTIONS OF HIGH ENERGY PARTICLES WITH NUCLEI. Kostanashvili, N. I.; Lebedevich, G. I.; Nabichvrishvili, D. S.; Kharashvili, G. I. (Tbilisi State Univ., USSR). Yadern. Fiz.; 16: No. 5, 983-988 (1972). (In Russian).

Production of π-mesons with energies in the Coulomb barrier of parent nuclei was studied at different energies and charges of

primary particles. The experimental data were analyzed with the view to determine the potential parameters of interactions of slow π-mesons with nuclei. (auth)

20936 ANOMALOUS ENHANCEMENTS IN MULTIPLE-PION PRODUCTION WITH DEUTERONS. Risser, T.; Shuster, M. D. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Lett.; 43B: No. 1, 68-72(8 Jan 1973).

The reaction $NN \rightarrow d\pi\pi$ is studied at intermediate energies in the Δ-isobar model. A large enhancement for low ππ masses in the isospin-singlet channel (ABC effect), the overall suppression of the isospin-triplet channel, and certain other features are predicted. (auth)

20937 NONRELATIVISTIC POTENTIAL MODEL WITH FORBIDDEN STATES FOR THE NUCLEON–NUCLEON INTERACTION AT SMALL DISTANCES. Neudatchin, V. G.; Obukovskii, I. T.; Smirnov, Yu. F. (Moscow State Univ.). Phys. Lett.; 43B: No. 1, 13-16(8 Jan 1973).

The potential considered, being as effective as the L-dependent Reid potential in the region $E_{lab} < 400$ MeV, gives a new unified description of phase shifts at higher energies and eliminates the disagreement with experiment of the M1 electronic form factor for the deuteron. The procedure of exclusion of forbidden states in the three-body problem is briefly outlined. (auth)

20938 SIXTH-ORDER EFFECTS IN NUCLEON–NUCLEON SCATTERING. Gammel, J. L. (Los Alamos Scientific Lab., NM). J. Comput. Phys.; 10: No. 3, 568-606(Dec 1972).

Some of the series resulting from quantum field theory are known to be summable by Padé approximants. As a test of the feasibility of generating such series by numerically calculating the Feynman graphs in each order, we have calculated sixth order graphs for nucleon–nucleon scattering with pseudoscalar pion exchange. Graphs with a $\lambda\varphi^4$ interaction of the pions are also calculated. We find that a modification of the Monte Carlo technique is essential to obtain accuracy, and that certain variable transformations are necessary to eliminate integrable boundary singularities which remain after renormalization. A brief discussion of the physical significance of the magnitude of the sixth-order terms is included. (auth)

20939 FACTORIZATION OF TWO-PARTICLE T-MATRIX AND PROBLEM OF THREE NUCLEONS WITH GAUSSIAN POTENTIAL. Petrov, N. M. (Inst. of Theoretical Physics, Moscow). Yadern. Fiz.; 16: No. 6, 1329-1335(1972). (In Russian).

On the basis of approximating the potential in momentum representation by separable series there is considered a problem on motion of two and three nucleons. For a local Gaussian potential two-nucleon and three nucleon low-energy parameters were calculated. The results obtained are compared with experimental results and those obtained in other papers. (auth)

20940 HADRONIC CASCADE CALCULATIONS OF ANGULAR DISTRIBUTIONS OF INTEGRATED SECONDARY PARTICLE FLUXES FROM EXTERNAL TARGETS AND NEW EMPIRICAL FORMULAE DESCRIBING PARTICLE PRODUCTION PROTON–NUCLEUS COLLISIONS. Ranft, J.; Routti, J. T. (CERN, Geneva). Particle Accel.; 4: No. 2, 101-110(Dec 1972).

Empirical formulas are described which represent the production of secondary pions and protons in high energy p-nucleus collisions; these have been introduced into hadronic cascade calculations. In addition, an empirical formula describing the production of low energy secondary protons and neutrons emitted by intranuclear cascade processes in hadron–nucleus collisions is proposed. By its use the intranuclear cascade particle can be introduced into computer programs calculating particle fluxes emerging from an external target hit by a high energy proton beam. The angular distributions calculated in this way are found to be in good agreement with experimental results obtained using activation detectors having different threshold energies. (auth)

20941 TWO-NUCLEON EFFECTIVE-RANGE PARAMETERS WITH TENSOR FORCES. Lovitch, L.; Rosati, C. (Univ., Pisa, Italy). Comput. Phys. Commun.; 4: No. 1, 138-146(Oct 1972).

The subroutine EFRNG written in FORTRAN IV for the IBM 7090 is described for the calculation of scattering length, effective range, low energy scattering behavior, and phenomenological potentials for n + p scattering described by central, tensor, and spin-orbit potentials. (JFP)

Particle Invariance Principles and Symmetries

General

20942 (ITF-72-149-P) TOPOLOGY OF THE REAL LIE GROUPS OF SMALL DIMENSIONALITY. III. Osinovskii, M. E. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 20p. (In Russian). Dep. NTIS (U. S. Sales Only).

A well known classification of the real Lie algebras of dimensionality from 1 to 4 is used to define the Lie groups with these algebras and to investigate their topological structure. (auth)

20943 GOLDSTONE THEOREM, MASSLESS PARTICLES, AND THE INTERACTIONS OF MATTER. van der Merwe, P. du T. (Atomic Energy Board, Pretoria). pp I.1-16 of Fifth Annual Seminar on Theoretical Physics. Pretoria; Atomic Energy Board (1970).

From 5th annual seminar on theoretical physics; Pretoria, South Africa (13 Jul 1970). See CONF-700728.

Lectures are presented on the dynamical breakdown of internal symmetries on the basis of the Goldstone theorem and the notion of a degenerate vacuum, which attempts to take into account the effects of the preponderance of certain isospin members over their fellow members. The Noether theorem, the Goldstone theorem, and chiral-invariant composite particle models are treated. (JFP)

20944 SPIN HAMILTONIAN. Caola, M. J. J. Phys., A (London); 5: No. 12, 1649-1657(Dec 1972).

A spin hamiltonian V(S) is derived for the g fold degenerate level of a system perturbed in first order by a physical perturbation V; the derivation explicitly relates the coefficients a, b, c, ... of V(S) to the matrix elements V_{MM}, of V between the zero order physical basis functions ψ_M. It is shown how the symmetry of V and time reversal affect V(S), and consider three often treated examples as an illustration of the power and unity of the method. (auth)

20945 SU(3) IN AN O(3) BASIS. 1. Properties of Shift Operators. Hughes, J. W. B. (Queen Mary Coll., London). J. Phys., A (London); 6: No. 1. 48-57(Jan 1973).

With a view to obtaining an orthogonal solution to the state labelling problem of SU(3) in an O(3) basis, four independent operators which shift the eigenvalues of the O(3) Casimir operator L^2 are constructed. The hermiticity properties of these operators, and of certain of their products which commute with L^2, are discussed. (auth)

Applications (Electromagnetic and Weak)

20946 (RPP/T-39) THREE TRIPLET REALIZATIONS OF GAUGE MODELS AND DEEP INELASTIC SCATTERING. Love, A.; Nanopoulos, D. V.; Ross, G. G. (Rutherford High Energy Lab., Chilton (England)). Dec 1972. 18p. Dep. NTIS (U. S. Sales Only).

We investigate the predictions for very high energy inelastic neutrino scattering of three triplet realizations of the weak interaction gauge theories based on the groups O(3) and SU(2) × U(1). (auth)

20947 PARITY VIOLATION AND MODELS OF THE WEAK INTERACTION HAMILTONIAN. Trabert, K. K. Philadelphia; Univ. of Pennsylvania (1972). 90p. University Microfilms Order No. 73-1460.

Thesis (Ph.D).

The parity-violating weak force between two nucleons is evaluated for several models of the weak-interaction Hamiltonian density $\mathcal{H}_x(x)$ by computing a corresponding two-nucleon potential V_{12}^{PV}. (JFP)

20948 SPECTRUM GENERATING ALGEBRA FOR MESON RESONANCES. Tait, W. (Univ., Paris). Int. J. Theor. Phys.; 6: No. 6, 453-466(Dec 1972).

The algebra SO(6,1) is considered as a unification of SO(6), which is isomorphic to SU(4) ⊃ SU(3), and the de Sitter algebra SO(4,1). The latter replaces the Poincaré algebra as the algebra of the group of motions of physical space-time. A representation of SO(6,1) is constructed, which, on restriction to SU(3), decomposes into the direct sum of all SU(3) representations, each occurring just once in the decomposition. The expectation values of the mass-squared operator, when evaluated in the octet, give accurate mass formulae for the octets of 1^- and 2^+ meson resonances. (auth)

Applications (Strong)

Refer also to abstract 20960.

20949 LINEARIZATION AND SYMMETRY BREAKING IN NONLINEAR SU(3) × SU(3). Dondi, P. H. (Cambridge Univ., Eng.). J. Phys., A (London); 5: No. 12, 1689-1697(Dec 1972).

A method for constructing linear representations from nonlinearly transforming pseudoscalar mesons is developed for

the group SU(3) × SU(3). The use of these functions as symmetry breaking terms is made apparent in phenomenological Lagrangians and current theories where the Schwinger term plays a particularly natural role as the symmetry breaker. (auth)

20950 CHIRAL SUPERPROPAGATOR FOR PIONS. Davies, P. T. (Queen Mary Coll., London). J. Phys., A (London); 5: No. 12, 1698-1705(Dec 1972).

The superpropagator constructed from a chiral SU(2) × SU(2) invariant Lagrangian is considered. It is shown how in general the complications arising from the derivative couplings can be separated from the nonpolynomial, nonderivative part; and the pion superpropagator is explicitly calculated for the unique choice of pion field that strict localizability requires. It is shown that an extension of the Efimov–Fradkin Green function representation will give a multiplet to a multiplet second order functions from the superpropagator. (auth)

Field Theories

General

20951 MODELS OF PARTICLES AND MOVING MEDIA. Dunn, D. A. New York; Academic Press, Inc. (1971). 312p. $15.00.

Fields of electrodynamics in which directed motion of either free charges or conducting media occurs are treated. Space–time and the Galilean transformation, the Lorentz transformation of time and space and Maxwell equations, forces and wave interaction with uniformly moving circuits and continua, nonuniform motion of charged particles in prescribed electric and magnetic fields, motion of many interacting particle in the Lagrangian model, and the motion of charged and conducting fluids in the Eulerian model are covered. (JFP)

Quantum Field Theory

Refer also to abstract 20818.

20952 (DESY-72/78) QUANTUM FIELD THEORY MODELS WITH DERIVATIVE COUPLINGS AND ISOTOPIC SPIN. Tarski, J. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Dec 1972. 17p. Dep. NTIS (U. S. Sales Only).

Several two-dimensional models are discussed heuristically, and are suggested as subject for investigation in the framework of constructive field theory. These models are nonsuperrenormalizable and also nontrivial. Furthermore, a class of renormalizable models with nonlocalizable solutions is noted. (auth)

20953 (IC-73/2) PROGRESS IN RENORMALIZATION THEORY SINCE 1949. Salam, A. (International Centre for Theoretical Physics, Trieste (Italy)). Jan 1973. 18p. (CONF-720982-2). Dep. NTIS (U. S. Sales Only).

From International Symposium on the physicist's conception of nature; Trieste, Italy (18 Sep 1972).

The discussion of renormalization theory covers the class of renormalization theories, the modification required to compute δm and δe finitely, gauge theories and spontaneous breaking of symmetries, a renormalizable unified theory of weak and electromagnetic interactions, and the formulation from renormalizable to finite theories. (JFP)

20954 (IFVE-STF-71-70) QUASICLASSICAL APPROXIMATION IN THE QUANTUM FIELD THEORY. Arkhipov, A. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 13p. (In Russian). INIS.

A quasiclassical approximation in the quantum field theory was obtained by means of the quasipotential equation of Logunov–Tavkhelidz. In this approximation the inverse problem of scattering was solved. (tr-auth)

20955 (ITF-72-127-E) EXAMPLE OF A SELF-LOCALIZED NONLINEAR RELATIVISTIC FIELD. Davydov, A. S.; Kislukha, N. I. (Akademiya nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 13p. Dep. NTIS (U. S. Sales Only).

A real scalar relativistic field with self-action $\lambda\varphi^4/4$ in the Lagrangian is investigated. An exact solution for the one-dimensional and three-dimensional cases is obtained. It is shown that for the one-dimensional case the field is localized in a certain region the size of which varies according to the Lorentz transformation. The field momentum and energy are inversely proportional to the coupling constant. The relativistic relation between them is the same as that for the particle with some internal energy. In a three-dimensional case a solution in the form of a plane front, localized in one dimension, and an approximate solution, which in the static case transforms into spherically symmetrical localized field, is found. (auth)

20956 (ITF-72-160-E) EXISTENCE OF GREEN'S FUNCTIONS IN THE EUCLIDEAN DOMAIN FOR $P(\varphi_2)$ THEORY. Gachok, V. P.; Gonchar, N. S. (Akademiya nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 15p. Dep. NTIS (U. S. Sales Only).

The existence of Green's functions for $P(\varphi_2)$ theory in the Euclidean domain without space-time cutoffs is proved. For this purpose we use the hypercontractive semigroup theory. (auth)

20957 (JINR-P2-6888) UNITARITY OF RENORMALIZED S MATRIX IN NONLOCAL FIELD THEORY. Alebastrov, V. A.; Efimov, G. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

Unitarity of the renormalized S-matrix in a nonlocal quantum theory of a scalar field is proved. (auth)

20958 FIFTH ANNUAL SEMINAR ON THEORETICAL PHYSICS. Conference Held at Pretoria, South Africa, July 13–17, 1970. Pretoria; Atomic Energy Board (1970). 306p. (In English and Afrikaans). (CONF-700728).

Separate abstracts were prepared for each of the papers in this volume. (RWR)

For abstracts of individual papers see: 20582, 20817, 20870, 20885, 20943, 20959, 20960, 20974, 21180–21185, and 21526.

20959 NONPERTURBATIVE SOLUTION OF A NONLINEAR FIELD EQUATION OF MOTION. van der Spuy, E. (Atomic Energy Board, Pelindaba, South Africa). pp K.1-65 of Fifth Annual Seminar on Theoretical Physics. Pretoria; Atomic Energy Board (1970).

From 5th annual seminar on theoretical physics; Pretoria, South Africa (13 Jul 1970). See CONF-700728.

A study is made of the sense in which the fundamental infinite-component generalized free field can provide a nonperturbative solution of the nonlinear field equation of motion in a CPT and Lorentz invariant manner. (JFP)

20960 SYMMETRY DISEASES IN LOCAL RELATIVISTIC QUANTUM FIELD THEORIES. Westenholz, C. v. pp M.1-27 of Fifth Annual Seminar on Theoretical Physics. Pretoria; Atomic Energy Board (1970).

From 5th annual seminar on theoretical physics; Pretoria, South Africa (13 Jul 1970). See CONF-700728.

The approximate nature of certain continuous symmetries within the framework of a local relativistic quantum field theory will be discussed. Especially the breakdown of the so-called internal symmetry groups related to the large mass differences between particles of some multiplot (like for instance baryons or mesons) will be analyzed. Attention is focussed on the following problem: Are there nontrivial couplings of space-time and internal symmetry? And what is the relation between the inhomogeneous Lorentz group and the internal symmetry? (auth)

20961 MODEL OF FIELD THEORY TREATED IN THE FOCK–COOK FORMALISM. Schroeck, F. E. Jr. (Florida Atlantic Univ., Boca Raton). J. Math. Phys. (N. Y.); 14: No. 1, 130-138(Jan 1973).

We present an alternative to the usual formalism for quantum field theory by generalizing the Fock–Cook formalism. We illustrate the method by applying it to a generalization of a familiar model of quantum field theory. (auth)

20962 PATH INTEGRAL APPROACH TO QUANTUM GAUGE FIELD THEORIES. Lake, T. W. Philadelphia; Univ. of Pennsylvania (1972). 177p. University Microfilms Order No. 73-1410.

Thesis (Ph.D).

Properties of operator gauge field theories, in particular of the SU(2) Yang–Mills theory, are examined. The correspondence between quantities under the path integral and operators is established in radiation and axial gauges and the gauge with scalar potential zero. The radiation gauge operator theory is identical to that of Schwinger. The gauge equivalence of locally gauge invariant operator expressions between different gauges is studied by means of a limiting process on certain nonlocally gauge invariant expressions under the path integral and their operator equivalents. The form of Schwinger's radiation gauge Hamiltonian is clarified by this procedure. There are also some remarks on the effects of boundary conditions on the method of Fadeev and Popov and on the properties of the path integral in the case of electromagnetism in Landau gauge, as an example of a theory with higher order differential equations. (Diss. Abstr. Int., B)

20963 LOCALITY CONDITIONS ON FORM FACTORS. Andersson, B. (Princeton Univ., NJ). J. Math. Phys. (N.Y.); 14: No. 1, 26-41(Jan 1973).

We derive a set of integral equations which are necessary and sufficient conditions on the form factors of local field theory, i.e., on the matrix elements of local operators. The basic idea is that out of the set of all (distribution-valued) functions defined on the boundary of an analyticity domain, in general only a subset are boundary values of functions which are analytic within the domain. The form factors are boundary values of a vertex function which, due to the general assumptions of locality, reasonable energy, and mass spectrum and Poincaré covariance, is analytic at least in the domain constructed by Kallen and Wightman. The characteristic boundary of the domain ("the distinguished boundary") is the set of physical values of the arguments of the form factors, and the integral equations in that way only involve such values. The main advantages in formulating the locality conditions in this way are that only the physical quantities of the field theory, i.e., the matrix elements between the field operators, enter into the equations and the frustrating complications which are met in the construction of the domains of analyticity for n-point functions with $n > 3$ might hopefully be avoided because the distinguished boundary can be constructed even if the whole domain is not known. The integral equations have naturally no unique solutions, because, e.g., all perturbation-theoretical form factors must, of course, fulfill them. The equations may, however, function as a convenient starting point for approximations and "model building" for form factors outside the presently used perturbation theories. The integral equations are straightforward generalizations of the notion of "weak local commutativity" for the two-point function. This condition means that the two spectral functions connected to two locally commuting operators should be equal. The conditions on the form factors (which are the generalizations of the two-point spectral functions) are that the difference should vanish when integrated over certain physical sets of mass space. (auth)

20964 GENERALIZED RELATIVISTIC FOCK SPACE. Marx, E. (Drexel Univ., Philadelphia). Int. J. Theor. Phys.; 6: No. 5, 359-363 (Dec 1972).

A generalized Fock space is considered which is obtained by eliminating the restriction to symmetric components for bosons or antisymmetric ones for fermions. In this space the many times formalism of relativistic quantum mechanics can be extended to quantum field theory, in which each particle has a time parameter that has to be included in any exchange of variables. Physical states in which all particle times, or all antiparticle times, are equal, still have the right symmetry. Creation and annihilation operators are defined for numbered particles in this space, and related to the usual operators. (auth)

20965 INVARIANT SIMULTANEITY. Kantor, W. Czech. J. Phys.; 22: No. 11, 1029-1055 (1972).

The concept of the "relativity of simultaneity," as a consequence of the Lorentz transformation, is shown to be an unproven inference based on the implicit idea that simultaneity can be determined only on the basis of synchroneity. The Lorentz transformations do imply, by interpretive inference, a relativity of synchroneity whereby a "moving" system of synchronized clocks appears to be nonsynchronous, with constant nonzero time invariant phases among the clocks that depend only on their relative fixed distances from each other. It does not seem to have been recognized that such an array of uniformly running nonsynchronous clocks, described as isochronous, can also lead to the unambiguous determination of simultaneity. The important significance of the relative temporal phases, namely the relativity of synchroneity, entailed by the Lorentz transformations is that certain alleged logical inconsistencies, asserted by both proponents and opponents of the special theory of relativity, can be readily resolved. The relativity of synchroneity does, however, raise certain other consequences that merit attention and careful consideration. (auth)

20966 ASYMPTOTIC ESTIMATIONS FOR QUASIPOTENTIAL PARAMETERS. Goloskokov, S. V.; Matveev, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 6, 1297-1301 (1972). (In Russian).

Bounds for quasipotential parameters, which do not violate strict requirements for physical values, proved in local field quantum theory have been obtained. (auth)

Gravitation and General Relativity

Refer also to abstract 20599.

20967 (ORO-3992-117) NOTE ON EXTENSIONS OF SPACE-TIMES. Hwang, A. E.; Duncan, D. P. (Texas Univ., Austin. Center for Particle Theory). Jan 1973. Contract AT(40-1)-3992. 21p. (CPT-171). Dep. NTIS.

It is shown that a maximal extension of the bundle of orthonormal frames over a spacetime gives rise to a maximal extension of the spacetime. This result enables one to directly apply several criteria which assume the inextendability of Riemannian manifolds to the study of the inextendability of spacetimes. These criteria are chosen on the basis of their simplicity and physical relevance. In particular, no complicated constructions are required to apply these criteria to spacetimes. We also demonstrate the usefulness of the bundle approach by explicitly constructing the well known Krushal–Szekeres extension of the Schwarzschild solution. (auth)

20968 ETHER FLOW THROUGH A DRAINHOLE: A PARTICLE MODEL IN GENERAL RELATIVITY. Ellis, H. G. (Univ. of Colorado, Boulder). J. Math. Phys. (N. Y.); 14: No. 1, 104-118 (Jan 1973).

The Schwarzschild manifold of general relativity theory is unsatisfactory as a particle model because the singularity at the origin makes it geodesically incomplete. A coupling of the geometry of space-time to a scalar field ϕ produces in its stead a static, spherically symmetric, geodesically complete, horizonless space-time manifold with a topological hole, termed a drainhole, in its center. The coupling is $R_{\mu\nu} = 2\phi_\mu\phi_\nu$; its polarity is reversed from the usual to allow both the negative curvatures found in the drainhole and the completeness of the geodesics. The scalar field satisfies the scalar wave equation $\Box\phi = 0$ and has finite total energy whose magnitude, expressed as a length, is comparable to the drainhole radius. On one side of the drainhole the manifold is asymptotic to a Schwarzschild manifold with positive mass parameter m, on the other to a Schwarzschild manifold with negative mass parameter m, and $-m > m$. The two-sided particle thus modeled attracts matter on the one side and, with greater strength, repels it on the other. If m is one proton mass, then $-m/m \approx 1 + 10^{-19}$ or $1 + 10^{-39}$, according as the drainhole radius is close to 10^{-33} cm or close to 10^{-13} cm; the ratios of total scalar field energy to m in these instances are 10^{19} and 10^{39}. A radially directed vector field which presents itself is interpreted, for purposes of conceptualization, as the velocity of a flowing "substantial ether" whose nonrigid motions manifest themselves as gravitational phenomena. When the ether is at rest, the two-sided particle has no mass on either side, but the drainhole remains open and is able to trap test particles for any finite length of time, then release them without ever accelerating them; some it can trap for all time without accelerating them. This massless, chargeless, spinless, particle can, if disturbed, dematerialize into a scalar-field wave propagating at the wave speed characteristic of the space-time manifold. (auth)

20969 RADIATION FIELDS IN THE SCHWARZSCHILD BACKGROUND. Bardeen, J. M. (Univ. of Washington, Seattle); Press, W. H. J. Math. Phys. (N. Y.); 14: No. 1, 7-19 (Jan 1973).

Scalar, electromagnetic, and gravitational test fields in the Schwarzschild background are examined with the help of the general retarded solution of a single master wave equation. The solution for each multipole is generated by a single arbitrary function of retarded time, the retarded multipole moment. We impose only those restrictions on the time dependence of the multipole moment which are required for physical regularity. We find physically well behaved solutions which do not satisfy the Penrose peeling theorems at past null infinity and/or do not have well defined Newman–Penrose quantities. Even when the NP quantities exist, they are not measurable; they represent an "average" multipole moment over the infinite past, and their conservation is essentially trivial. (auth)

20970 KERR GEOMETRY AS COMPLEXIFIED SCHWARZSCHILD GEOMETRY. Schiffer, M. M. (Stanford Univ., CA); Adler, R. J.; Mark, J.; Sheffield, C. J. Math. Phys. (N. Y.); 14: No. 1, 52-56 (Jan 1973).

We present a simple derivation of the Schwarzschild and Kerr geometries by simplifying the Einstein free space field equations for the algebraically special form of metric studied by Kerr. This results in a system of two partial differential equations, the Laplace and eikonal equations, for a complex generating function. The metric tensor is a simple explicit functional of this generating function. The simplest solution generates the Schwarzschild geometry, while a displacement of the origin by ia in this solution generates the Kerr geometry. (auth)

20971 GENERAL RELATIVITY. Papers in Honour of J. L. Synge. O'Raifeartaigh, L. (ed.). New York; Oxford University Press (1962). 285p. $24.00.

The topics discussed cover Einstein's path from special to general relativity, the acceptability of Poincare versus Einstein theories, global and nonglobal problems in cosmology, the geometry of free fall and light propagation, invariance of Lagrangian systems, geometry of impulsive gravitational waves, exact solutions of Einstein–Maxwell equations for an accelerated charge, plane-symmetric similarity solutions for self-gravitating fluids, equa-

tions of motion in the linear approximation, and rotating bodies in general relativity. Also treated are a limiting case of relativistic equilibrium, the relativistic Boltzmann equation, and the self-consistent test-particle approach to relativistic kinetic theory. (JFP)

20972 WEYL LEMMA AS A TRANSPORT AND COUPLING RULE. Treder, H. J. (Institut fuer Relativistische und Extragalaktische Forschung, Potsdam, Ger.). Acta Phys. Acad. Sci. Hung.; 32: No. 1-4, 49-60(1972). (In German).

The Weyl lemma connects the coordinate-covariant derivatives of space-time tensors with the (local) Lorentz covariant derivatives of their measured values and with the (Lorentz-covariant) spinor-derivatives. The Lorentz-covariant derivatives may be reduced back to the coordinate-covariants on the basis of the Weyl lemma. For tensor quantities the Weyl lemma signifies a calibration provision for the free transport of measuring devices. The Weyl lemma further insures that the tensor fields which result from the fusion of spinor fields, suffice for the free space-time transport as the original tensor fields. The Weyl lemma is the general mathematical foundation for that which is understood more intuitively as "formalism of compensating fields". (tr-auth)

Scattering Theory

Refer also to abstracts 20917, 20954, and 20958.

20973 (ITF-72-184-E) REVIEW ON DAMA. Bugrii, A. I.; Cohen-Tannoudji, G.; Enkovskii, L. L.; Kobylinskii, N. A. (Akademiya nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 134p. Dep. NTIS (U. S. Sales Only).

We review the recent developments in the strong interaction theory based on dual amplitudes with Mandelstam analyticity (DAMA). (auth)

20974 VENEZIANO REPRESENTATION. Vanryckeghem, L. G. F. (Univ. of Cape Town). pp H.1-24 of Fifth Annual Seminar on Theoretical Physics. Pretoria; Atomic Energy Board (1970).

From 5th annual seminar on theoretical physics; Pretoria, South Africa (13 Jul 1970). See CONF-700728.

The Veneziano amplitude and its generalizations and successes in fitting actual data are studied. The general properties of the scattering amplitude, Regge poles in elastic scattering, daughters in the unequal-mass case, the Veneziano amplitude and its derivation, other representations, unitarization, and the generalized Veneziano amplitudes are treated. (JFP)

20975 SEMICLASSICAL EQUIVALENCE IN THE CASE OF NONSPHERICAL SCATTERING. Van Dop, H.; Tip, A. (FOM-Instituut voor Atoom- en Molecuulfysica, Amsterdam). Physica; 61: No. 4, 607-615(15 Oct 1972).

The station-phase method is applied to the eikonal amplitude for elastic small-angle scattering, both in the case of spherical, and nonspherical scattering. The correspondence between the resulting equations and the classical scattering formulas is shown, and some semiclassical equivalence relations are derived. (auth)

20976 EXPERIMENTAL KNOWLEDGE ON TWO BODY HELICITY AMPLITUDES AND A PHENOMENOLOGICAL REGGE CUT PRESCRIPTION. Tran Thanh Van, J. (Paris Univ., Orsay, France). pp 1-29 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.1).

The theoretical and experimental behaviors of helicity amplitudes are compared in detail. A very simple modification of the Regge cut model is shown to be able to completely describe all pseudoscalar-meson–baryon interactions. (France)

20977 UNITARITY, DUALITY, AND ABSORPTION. Kane, G. L. (Science Research Council, Chilton, Eng.). pp 369-390 of Proceedings of the 7th Rencontre de Moriond. Vol. 1. Tran Thanh Van, J. (ed.). Paris; Centre National de la Recherche Scientifique (1972).

From 7th Rencontre de Moriond Conference; Meribel-les-Allues, France (5 Mar 1972). See CONF-720333-(Vol.1).

A definite model is proposed which answers to duality between resonance and Regge poles or Regge poles plus absorptive cuts and, in general, to close relations between high energy and low energy amplitudes. (France)

20978 FAST PARTICLE SCATTERING ON EFFECTIVELY INCREASING POTENTIAL. Kalashnikov, N. P.; Mur, V. D. (Moscow Engineering-Physics Inst.). Yadern. Fiz.; 16: No. 5, 1117-1124(1972). (In Russian).

On the basis of eikonal approximation the amplitude for elastic scattering on effectively increasing potential is being studied. The scattering amplitude behavior as a function of the transferred momenta is studied in the case of the interaction radius increasing with energy. Coherent scattering of fast charged particles in a monocrystal was considered. (auth)

20979 SATURATION OF THE DIFFRACTION PEAK TO THE UNITARITY BOUND. Arai, M. (Tokyo Univ.). Phys. Lett.; 43B: No. 1, 41-43(8 Jan 1973).

A lower bound on the second derivative of the absorptive part of the forward scattering amplitude with respect to the momentum transfer is obtained from unitarity. When saturated to the bound, and if the absorptive part behaves like $\beta(t)s^{\alpha(t)}$ for high-energy scattering, one can show $\alpha(t) \equiv \sigma_{tot}/\sigma_{el.} \geq 3/2$. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

20980 DISCONTINUITIES IN HELIUM II. Hills, R. N. (Heriot–Watt Univ., Edinburgh). Appl. Sci. Res. (The Hague); 27: No. 2-3, 145-155(Dec 1972).

The jump conditions at surface of discontinuity are derived for the two-fluid model of helium II from postulated balance laws for the total energy, the linear momentum of the superfluid and from an entropy production inequality. These conditions are used to discuss a contact surface and the propagation of a weak shock. (auth)

20981 DISPERSION OF THERMAL WAVES IN He II WITH THE NORMAL COMPONENT DAMPING. Dikina, L. S.; Esel'son, B. N.; Novikov, P. S.; Rudavskii, E. Ya. (Physical Technical Inst. of Low Temperatures, Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 12, 1989-1996(Dec 1972). (In Russian).

The velocity of thermal waves in narrow channels filled with He II is investigated experimentally. The dispersion of the thermal wave velocity is studied which is related to partial damping of the normal component. In this case the temperature and frequency dependences of the velocity are in good agreement with the theory. (auth)

Superconductivity

Refer also to abstracts 20362, 21410, and 21555.

20982 CALCULATION OF THE TEMPERATURE DEPENDENCE OF THE ELECTROMAGNETIC COHERENCE LENGTH IN SUPERCONDUCTORS. Ginsberg, D. M. (Univ. of Illinois, Urbana). Phys. Rev., B; 7: No. 1, 146-9(1 Jan 1973).

The temperature dependence of the electromagnetic coherence length is calculated for superconductors in which the ratio of the zero-temperature energy-gap width to the critical temperature may differ from the BCS value. The calculation is based on the experimentally verified similarity principle that the ratio of the energy-gap width to its value at absolute zero is approximately a universal function of the reduced temperature $t = T/T_c$. (auth)

20983 NONLINEAR BESSEL EQUATION. Kametaka, Yoshinori (Osaka City Univ.). Publ. Res. Inst. Math. Sci.; 8: No. 1, 151-200(Jul 1972).

In the theory of Type-II superconductivity, the Abrikosov mixed state may be described as a special solution of the Ginzburg–Landau equation. To describe one flux line Abrikosov derived from the Ginzburg–Landau equation the singular boundary value problem for a nonlinear Bessel equation. Theorems relative to this equation are derived and presented. (MHR)

20984 SOME FEATURES OF VISCOUS FLOW OF VORTEXES IN SUPERCONDUCTING ALLOYS NEAR THE CRITICAL TEMPERATURE. Gor'kov, L. P.; Kopnin, N. B. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 1, 356-370(Jan 1973). (In Russian).

Time equations for slow ($\omega \ll \Delta$) movement of the vortex structure in alloys with $l \ll \xi(T)$ near T_c are derived on basis of the microscopic superconductivity theory. The major role is played by the a term responsible for the slow diffusion mechanism of relaxation. The motion of vortex lines is considered for the case when the magnetic field $H \ll H_{c2}$. This relaxation mechanism leads to a large value of the viscosity coefficient. (auth)

20985 ALTERATION OF THE SUPERCONDUCTING PROPERTIES OF VANADIUM DUE TO INTRODUCTION OF IMPURITY TANTALUM ATOMS. Chernoplekov, N. A.; Panova, G. Kh.; Samoilov, B. N.; Shikov, A. A. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 64: No. 1, 195-204(Jan 1973). (In Russian).

The transition temperature to the superconducting state T_c, temperature dependence of specific heat in the 1.5–40°K range in the absence of a field or in a field ~18 kOe and electrical conductivity between 5 and 1000°K are measured for dilute solutions of Ta in V. The experimental data are compared with calculations based on the MacMillan [JETP,38, 966(1960); 39, 1437(1960)] and Maksimov [Phys. Rev. 167, 331(1968)] theory. It is shown that decrease of T_c is primarily due to weakening of electron–phonon interaction by a softening of the crystal phonon spectrum in the presence of the impurity due to the appearance of quasilocal oscillations. The variation of T_c qualitatively can also be explained on basis of data pertaining to variation of the phonon spectrum of an impurity-containing crystal and variation of the amplitude for scattering of electrons by ions. A correlation is observed between variation of the electric resistance of alloys at high temperatures $T \geq 2\theta$ and variation of electron-phonon interaction. (auth)

20986 PSEUDOPOTENTIAL CALCULATION OF THE SUPERCONDUCTING TRANSITION TEMPERATURE FOR SIMPLE METALS. Gupta, H. C.; Tripathi, B. B. (Indian Inst. of Tech., New Delhi). Indian J. Pure Appl. Phys.; 10: No. 7, 506-507 (Jul 1972).

A simple method to calculate the superconducting transition temperature for simple metal superconductors is presented. A modified form of Harrison's model pseudopotential was used to obtain the electron–phonon coupling. Good agreement between calculated and experimental values of the superconducting transition temperature was found. It is predicted that lithium should be superconducting at low temperatures. (auth)

20987 SURFACE IMPEDANCE OF TYPE-I SUPERCONDUCTORS IN A WEAK MAGNETIC FIELD. Kaner, E. A.; Yampolskii, V. A. (Inst. of Radiophysics and Electronics, Kharkov). Phys. Status Solidi (b); 55: No. 1, 79-86(1 Jan 1973).

The electromagnetic absorption is investigated theoretically in Type-I superconductors placed in a weak magnetic field parallel to the surface of the specimen. A shallow potential box has been considered which contains a single magnetic surface level. The energy of the surface state is calculated. At zero temperature, the electromagnetic absorption threshold decreases. At temperatures of the order of the energy gap, the surface impedance possesses a logarithmic singularity at the frequency corresponding to the excitation transition from the magnetic surface level into continuum. The temperature dependence of the electromagnetic absorption is derived also. (auth)

20988 SUPERCONDUCTING PROPERTIES OF THE MEMORY-TYPE CHALCOGENIDE $Te_{0.81}Ge_{0.15}As_{0.04}$. Neuringer, L. J. (Massachusetts Inst. of Tech., Cambridge); Sample, H. H.; Gerber, J. A.; De Neufville, J. pp 329-37 of Conduction in Low-Mobility Materials. /Klein, N. (ed.). London; Taylor and Francis Ltd. (1971).

From 2nd international conference on conduction in low-mobility materials; Eilat, Israel (5 Apr 1971). See CONF-710464.

The ternary chalcogenide $Te_{0.81}Ge_{0.15}As_{0.04}$ in the memory state is found to become superconducting with a transition temperature in the vicinity of 0.8°K as measured by the resistance method. Both the transition temperature and upper critical field of the ternary alloy are higher than that of Ge_xTe_{1-x} alloys studied heretofore. On the basis of its transition temperature the superconducting phase appears to be other than either of the two main components, crystalline GeTe and As-doped Te, thought to be present in the memory state of the ternary material. (auth)

20989 STUDY OF DILUTE MAGNETIC ALLOYS USING SUPERCONDUCTING PROXIMITY. Dumoulin, L.; Nedellec, P.; Guyon, E. (Paris Univ., Orsay, France). Solid State Commun.; 11: No. 11, 1551-5(1 Dec 1972).

The magnetic properties of the Cu series of dilute alloy films (X = Mn, Cr, Fe) were investigated, from the critical temperature of Pb/CuX superconducting sandwiches, as compared with Pb/Cu ones. A quantitative analysis of the thickness dependence of T_c, based on the tunneling model of the proximity effect, leads to an estimation of the magnetic depairing energy for different concentrations. A tentative analysis of the data is given in terms of the Kondo effect in these dilute alloys. (auth)

20990 OCCURRENCE OF MAGNETISM IN SUPERCONDUCTORS. Bennemann, K. H. (Univ. of Rochester, NY); Garland, J. W. pp 512-566 of Dynamical Aspects of Critical Phenomena. Budnick, J. I. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From Conference on Dynamical Aspects of Critical Phenomena; New York, United States of America (USA) (9 Jun 1970). See CONF-700674-.

How magnetic phenomena affect superconductivity in simple metals, transition metals and alloys thereof, and dilute rare-earth alloys is discussed. It is shown both qualitatively and quantitatively that superconductors are sensitive probes for studying itinerant spin excitations, local spin excitations associated with nearly magnetic impurities, the effect of the atomic environment on the stability of local magnetic moments, and the nature of the spin order in rare-earth alloys. Also, it is discussed how magnetic impurities can be used to study the electronic configuration which is responsible for superconductivity in Laves-phase crystals like A15 compounds and β-tungsten crystals, for example. (auth)

20991 ANOMALOUS ATTENUATION OF LONGITUDINAL ULTRASOUND IN THE INTERMEDIATE STATE OF PURE TYPE I SUPERCONDUCTOR. Shepelev, A. G.; Ledenev, O. P.; Filimonov, G. D. (Physical Technical Inst., Kharkov). Solid State Commun.; 12: No. 3, 241-244(1 Feb 1973).

The dependence of ultrasonic attenuation on the direction of magnetic field H ($H \perp k$) in intermediate state of very pure gallium at T = 0.5°K was found to be anomalously different from the dependence observed at the same temperature and $H = H_c$ in normal state. This phenomenon can be explained taking into account the anisotropy of the gallium Fermi surface. (auth)

20992 GINZBURG–LANDAU THEORY FOR SUPERCONDUCTORS. Cyrot, M. (Paris Univ., Orsay, France). Rep. Progr. Phys.; 36: No. 2, 103-158(1973).

This review article describes how the simple Ginzburg–Landau approach lies in the heart of the general theory of superconductors. An introduction is given to the handling of the theory and to the numerous possibilities of applications. A general free energy functional for a superconductor is given and the different cases where it can be reduced to a Ginzburg–Landau form or to a simple generalization of this form are studied. It is emphasized that applications are not restricted to thermodynamical ones as the Ginzburg–Landau approach can be used in the calculation of dissipative phenomena. The possibility of an extension to the time-dependent phenomena is discussed in detail to present the difficult problems which arise in that case. The gapless regime of type-II superconductors is given as an example. (auth)

20993 MEASUREMENT OF THE FLUX DENSITY DISTRIBUTION IN TYPE-2 SUPERCONDUCTORS WITH SEVERAL MICRO-FIELD PROBES. Weber, H. W.; Riegler, R. (Oesterreichische Hochschule, Vienna). Solid State Commun.; 12: No. 2, 121-124 (15 Jan 1973).

Results on the flux density distribution in several low-type-II superconductors differing in their degree of hysteresis are presented. In rather reversible samples distinct gradients are observed only at low fields, with increasing hysteresis the shape of the gradients differs from that expected for high-K materials. Furthermore, the direct observation of the flux distribution obtained upon cooling in an external field is described. (auth)

20994 NUCLEAR SPIN-LATTICE RELAXATION AND PAIR BREAKING IN SUPERCONDUCTING (LaGd)Al_2. MacLaughlin, D. E.; Daugherty, M.; Parvin, K. (Univ. of California, Riverside). Solid State Commun.; 12: No. 1, 5-7(1 Jan 1973).

Measured zero-field nuclear spin–lattice relaxation rates in the superconducting magnetic alloy (LaGd)Al_2 have been analyzed in terms of direct impurity and conduction-electron (Korringa) contributions. The temperature dependence of the Korringa rate exhibits the effect of impurity pair breaking near the superconducting transition. (auth)

20995 PHENOMENOLOGICAL THEORY OF THE INCREASE IN THE SUPERCONDUCTING TRANSITION TEMPERATURE IN THIN FILM LAYERED SANDWICHES. Antoniewicz, P. R.; Fredericks, G. E. (Univ. of Texas, Austin). Solid State Commun.; 12: No. 1, 23-26(1 Jan 1973).

A phenomenological theory is presented to account for the observed increase in the critical temperature, as a function of the number of layers, of multilayer sandwiches composed of alternating superconducting and insulating layers. The transition temperature of the layered compound $NbSe_2$ when cleaved down to a small number of layers and the pressure dependence of the transition temperature of bulk $NbSe_2$ can also be fitted into this scheme. (auth)

20996 CRYOCONDUCTORS AND SUPERCONDUCTORS. Kvet, K. Energetika; 22: No. 9, 393-398(Sep 1972). (In Czech.).

Mammoth power-production units require the use of new techniques for meeting the ever increasing technical demands. The present trend is toward utilizing cryotechniques in conjunction with super-pure metals and superconductor techniques. At low temperatures, the per-unit conductivity of highly pure metals increases by 3 to 4 orders with respect to the conductivity at normal temperatures. Examples are presented of applying the method to transformers, alternators and cable transmission lines. Recently evolved superconductors now make it possible to utilize such materials over a broader range of critical values. Several kinds of superconductors and their application to superconductive magnets, electrical machinery and long-distance cable lines are described. The prospects of utilizing the new findings in the further development of electric power equipment are also evaluated. (auth)

20997 SURFACE IMPEDANCE OF SUPERCONDUCTING LEAD FILMS WITH Bi IMPURITIES. Hasse, J.; Lachman, J. (Univ., Karlsruhe, Ger.). Z. Phys.; 258: No. 2, 136-146(1973). (In German).

Surface resistance and penetration depth of evaporated Pb–Bi alloys were measured. From comparison of theoretical values with experiments the mean free path was determined, which turned out to be much smaller at the surface in comparison to the bulk of the material. This difference decreased with Bi-content. No correlation of residual rf-absorption with mean free path was found. (auth)

20998 CRITICAL CURRENT DENSITY OF DEFORMED AND ANNEALED SUPERCONDUCTING Nb–26% Zr AND Nb–32% Zr AND ITS DEPENDENCE ON THE AMOUNT OF DEFORMATION. Finlayson, T. R.; Milne, I. (Central Electricity Research Labs., Leatherhead, Eng.). J. Mater. Sci.; 7: No. 12, 1391-1400(Dec 1972).

A study of the low-field critical current densities (computed from magnetization data) which can be achieved by heat-treating for 1 h Nb–Zr alloys deformed various amounts, has shown that a peak critical current density is always reached after annealing at around 750°C. The magnitude of this peak depends upon the amount of deformation, but is not increased by deforming beyond 80%. Superconducting transition temperatures are also reported. The microstructure was unusual in that deformation was very unevenly distributed and there was little tendency for the dislocations to cross-slip or to form a cellular structure. Precipitation of β_{Zr} occurred in regions of high deformation only, so that equilibrium was not achieved below 80% deformation. The measured superconducting properties are explained in terms of this microstructure, with β_{Zr} as the dominant flux pinning agent. (auth)

20999 NUCLEAR SPIN–LATTICE RELAXATION IN SMALL SUPERCONDUCTING PARTICLES. Simanek, E.; MacLaughlin, D. E.; Imbro, D. (Univ. of California, Riverside). Phys. Lett., A; 42A: No. 5, 357-358(1 Jan 1973).

A calculation of nuclear spin–lattice relaxation in zero-dimensional superconductors is described which uses the renormalization procedure of Abrahams et al. and Patton. The results agree with measurements of Kobayashi and co-workers on fine aluminum particles. (auth)

Equipment and Devices

Refer also to abstracts 20457 and 20475.

21000 (DESY-72/65) HELIUM GAS COOLED CURRENT LEADS IN A REFRIGERATOR COOLED SUPERCONDUCTIVE MAGNET SYSTEM. Horlitz, G.; Wolff, S.; Parsch, C. P. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Nov 1972. 18p. (CONF-720908-33). Dep. NTIS (U. S. Sales Only).

From 4th International Conference on Magnet Technology; Upton, New York, United States of America (USA) (19 Sep 1972).

Operating conditions for large superconductive magnets are maintained by helium refrigerators in closed refrigeration loops. Their current leads are cooled by helium being withdrawn from the gas returning to the cold end of the last heat exchanger of the refrigerator. The cooling gas flowing at a rate $\dot{m}_w$ is warmed up by heat exchange with the current leads and fed back to the main compressor of the refrigerator. The rate of cold gas returning to the refrigerator is reduced by an amount $\dot{m}_w$ and thus the refrigeration power is reduced as well. The influence of $\dot{m}_w$ on the refrigeration performance of the magnet-refrigerator system is investigated both theoretically and experimentally. Using the excess refrigeration power $\dot{Q}_e$ as a measure for the performance one can show that $\dot{Q}_e$ becomes rather small at $\dot{m}_w = 0$ due to the high heat conduction rate of uncooled copper leads. If $\dot{m}_w$ increases $\dot{Q}_e$ decreases again because no cold gas returns to the refrigerator. In the DESY 1.4 m/2.2 Tesla superconductive magnet system Pluto, $\dot{Q}_e$ was measured as a function of $\dot{m}_w$ for different currents between 0 and 1200 A. At the maximum $\dot{Q}_e = (\dot{Q}_e)_{max}$ the optimal value for the cooling flow rate $\dot{m}_w = \dot{m}_{w\,o}$ can be found. A new method for separating the heat losses of the system is derived from the asymptotic behavior of the $\dot{Q}_e = f(\dot{m}_w)$ relation. (auth)

21001 (KFK-1645) ON THE DEPENDENCE OF RF-SURFACE RESISTANCE WITH FIELD STRENGTH IN ANODIZED NIOBIUM CAVITIES BETWEEN 2 GHz AND 4 GHz. Kneisel, P. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Jul 1972. 62p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Technische Hochschule, Karlsruhe (West Germany).

Investigations are reported into the surface resistance of anodized niobium cavities in the frequency-range between 2 GHz and 4 GHz. The experiments have shown that a special surface treatment, consisting of a combination of electro-polishing, chemical

edging and anodizing, results in a strong dependence of the surface resistance on the rf-field strength. The measured values can be described by $R(T, H, f) = R_S(T, f) + R_{res}(f) + R_p(T, H, f)$ with $R_p(T, H \gg 10\ G, f) \rightarrow 0$. Several features of the term $R_p(T, H, f)$ can be explained by the model of "magnetic field induced surface states". The superconducting term $R_S(T, f)$ agrees well with the BCS-theory; the residual resistance $R_{res}(f)$ is temperature- and field-independent and changes with the frequency as $R_{res} \sim f^{1.2-2.0}$. Due to the special surface preparation surface resistances $< 2 \times 10^{-9}$ Ohm and rf-magnetic fields of 300 to 400 Gauss were achieved. (auth)

21002 JOSEPHSON EFFECTS IN GRANULAR SUPERCONDUCTORS AND WEAK LINKS. Warman, J. Stony Brook, NY; State Univ. of New York (1972). 93p. University Microfilms Order No. 72-30,475.

Thesis (Ph.D).

Some aspects of the detection of electromagnetic radiation by means of the Josephson effect were studied. In particular, the behavior of two geometries was investigated that might offer an alternative to the well known point contact geometry. These are the bulk granular superconductor (powder) junction and the superconducting (Dayem) bridge. For the powder junction, the character of the I–V and dV/dI–V curves, as well as their changes under the effect of applied magnetic and microwave fields are studied. Also, its potential as a practical detector was explored and its sensitivity measured. The study shows that the behavior of a powder junction can be probably understood in terms of an array of point contacts. Its sensitivity to microwave radiation is comparable to that of other geometries (10^{-13} W/$\sqrt{\text{Hz}}$ for broad band detection). Its mechanical and recycling properties, different from those of point contacts, might offer some advantages from the point of view of a practical detector. The broad band response of a superconducting bridge is determined by the enhancement of the critical current under the effect of a microwave field. The results show qualitative agreement with Eliasberg's theoretical model of the enhancement and indicate the need of more uniform and smaller bridges. The mechanical and recycling properties of this geometry make them very attractive as radiation detectors. An analysis is presented of the influence of the measuring circuit impedance on the observed I–V characteristics of a Josephson device. Josephson equations are solved numerically for the case in which the driving emf source for the device cannot be considered a perfect current or voltage source. The results explain the reported appearance of negative resistance in the I–V characteristics of some weak links. (Diss. Abstr. Int., B)

21003 SINGLE VORTEX PROPAGATION IN JOSEPHSON TUNNEL JUNCTIONS. Fulton, T. A.; Dynes, R. C. (Bell Telephone Labs., Murray Hill, NJ). Solid State Commun.; 12: No. 1, 57061(1 Jan 1973).

Certain finite-voltage current steps appearing in zero magnetic field in Josephson tunnel junctions are interpreted as arising from a novel process involving the inertial motion of one or more vortices in the junction. (auth)

21004 PROBLEMS IN DEVELOPMENT OF HIGH-POWER TURBOGENERATORS WITH SUPERCONDUCTIVE FIELD WINDINGS. Borzov, G. G.; Glevob, I. A.; Gnedin, L. P.; (and others). Izv. Akad. Nauk SSSR, Energ. Transp.; No. 4, 21-28(1972). (In Russian).

The advantages of cryogenic turbogenerators over conventional units are pointed out. Elements of construction of high powered cryogenic turbogenerators are described, and the results of model tests are presented. The analysis shows that using superconductors in the field windings increases the unit power of turbogenerators by an order of magnitude. The results of experimental studies confirm the feasibility of a synchronous machine with rotating cryostat that has low liquid helium evaporability and provides torque transfer. The realization of high-power cryogenic turbogenerators must wait for a great deal of research on development of new materials, structural and refrigeration units, and automatic monitoring and control systems. (JPRS)

21005 SELECTING THE PRINCIPAL DIMENSIONS OF A SYNCHRONOUS GENERATOR WITH SUPERCONDUCTING MAGNETO. Bertinov, A. I.; Mironov, O. M. Izv. Akad. Nauk SSSR, Energ. Transp.; No. 4, 29-38(1972). (In Russian).

A principal design equation is derived for a synchronous machine in which account is taken of the limiting critical relation between current density and magnetic field for the superconducting material of the field winding. A criterion is proposed for determining the principal characteristics of the generator. It is found that the leakage coefficient of the magnetic circuit in a synchronous generator with superconductive field winding assuming maximum power per unit volume of the magneto is about 0.60 to 0.75. An increase in the relative inside diameter of the magneto increases the outside diameter of the field winding and reduces the space taken up by the superconductor. Engineering methods are proposed for calculating the dimensions of the armature to give the required leakage coefficient of the magnetic circuit and relative inductive reactance of the armature winding. (JPRS)

21006 ELECTRODYNAMIC FORCES AND MECHANICAL STRESSES IN SUPERCONDUCTING MAGNETIC SYSTEMS. Novitskii, V. G.; Shakhtarin, V. N. Izv. Akad. Nauk SSSR, Energ. Transp.; No. 4, 50-55(1972). (In Russian).

A method is proposed for calculating mechanical stresses in a superconducting solenoid as a cylindrically anisotropic body in the presence of a radial body force which depends on the radius. The method accounts for the elastic constants of the material of the winding and the banding. Formulas are presented for calculating the moduli of elasticity and the Poisson ratios of a ribbon solenoid whose winding is made up of a superconductor, a stabilizing material and insulation. Expressions are also given for determining the electrodynamic forces between two circular coils for various relative positions. A stricter solution of the problem of finding mechanical stresses in a winding should take account of the axial component of the electrodynamic force acting on the conductors of the winding. (JPRS)

PHYSICS (NUCLEAR)

Neutron Interactions with Matter

Refer also to abstracts 19908, 21048, and 21962.

21007 (COO-3058-27) LINEAR ACCELERATOR PROJECT. Annual Technical Report, October 1, 1971–September 30, 1972. (Rensselaer Polytechnic Inst., Troy, N. Y.). 1972. Contract AT(11-1)-3058. 165p. Dep. NTIS.

ALUMINUM—Al–Fe, neutron spectra in two-region systems of, fast, (E/T)
—neutron spectra in, anisotropic analysis of fast, (T)
CALCIUM-40—neutron elastic scattering at 0.2 to 1.3 MeV, departure from statistical cross-section behavior, (E)
CHROMIUM-53—photon reactions (γ,n) with, calculation of partial radiative widths for, (T)
DEUTERIUM—neutron total cross section at 1 to 1000 keV, (E)
GOLD-197—neutron capture at 23.5 keV, effective cross sections for, (E)
HELIUM-3—neutron total cross section at 0.7 to 30 MeV, (E)
INDIUM—neutron capture at 23.5 keV, effective cross sections for, (E)
IRON—neutron total cross section at 22 to 25.5 keV, (E)
—neutron spectra in, anisotropic analysis of fast, (T)
IRON-54—neutron resonances at 3.10 to 39.1 keV from capture and transmission measurements, (E)
IRON-57—photon reactions (γ,n) with, calculation of partial radiative widths for, (T)
IRON-58—neutron resonances at 0.230 to 19.2 keV from capture and transmission measurements, (E)
LEAD—neutron time-dependent slowing-down spectra in, (E)
NEUTRON CROSS SECTIONS—rapid calculational methods for elastic transfer matrices, (T)
NEUTRONS—reactions (n,f) with uranium 235 at 0.008 to 28 eV, neutron multiplicity in, (E)
—reactions (n,f) with uranium-233 at 0.008 to 100 eV, neutron multiplicity in, (E)
—strength functions vs. A at 30, 100, and 300 keV, calculation using partial wave dependent optical model parameters, (T)
—scattering by nuclei at 30, 100, and 300 keV, calculation of potential scattering radius using partial wave dependent optical model parameters, (T)
—spectra in lead, time-dependent slowing-down, (E)
—transport through interfaces, application of continuous slowing-down theory to, (T)
NEUTRONS, FAST—reactions with helium 3 at 0.7 to 30 MeV, total cross section for, (E)
—scattering by calcium-40 at 0.2 to 1.3 MeV, departure from statistical behavior of cross sections for elastic, (E)
—spectra in metallic sodium, measurement and analysis of (E)
—spectra in two-region aluminum–iron systems, (E/T)
—spectra in metallic sodium, mean neutron emission times in, (E)
—spectra in aluminum, iron, and uranium, anisotropic analysis of, (T)
NEUTRONS, INTERMEDIATE—capture by indium, tantalum, gold, and uranium-238 at 23.5 keV, effective cross sections for, (E)
—reactions with iron at 22 to 25.5 keV, total cross section for, (E)
—reactions with deuterium at 1 to 1000 keV, total cross section for, (E)
—reactions with depleted uranium at 1 to 100 keV, total cross section for, (E)
NICKEL-61—neutron resonances at 1.35 to 21.3 keV from capture and transmission measurements, (E)
—photon reactions (γ,n) with, calculation of partial radiative widths for, (T)
NICKEL-64—neutron resonances at 14.3 to 82.8 keV from capture and transmission measurements, (E)
NUCLEAR MODELS—optical, neutron strength functions using partial wave dependent parameters, (T)
PHOTONS—reactions (γ,n) with iron-57, chromium-53, and nickel-61, calculation of partial radiative widths for, (T)
RADIATION TARGETS—design and performance of neutron-producing, (E)
SODIUM—neutron spectra in metallic, measurement and analysis of fast, (E)
—neutron spectra in metallic, mean neutron emission times in pulsed experiments, (E)
—neutron cross sections for, isotropic elastic group constants for, (T)
TANTALUM-181—neutron capture at 23.5 keV, effective cross sections for, (E)
URANIUM—neutron total cross section of depleted, at 1 to 100 keV, (E)
—neutron spectra in, anisotropic analysis of fast, (T)
URANIUM-233—neutron fission at 0.008 to 100 eV, neutron multiplicity in, (E)
URANIUM-235—neutron fission at 0.008 to 28 eV, neutron multiplicity in, (E)
URANIUM-238—neutron capture at 23.5 keV, effective cross sections for, (E) (LTW)

21008 (FEI-288) CORRECTION FOR MULTIPLE NEUTRON SCATTERING IN THE "THIN" SAMPLES. Shorin, V. S. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1971. 8p. (In Russian). INIS.

The effects of multiple scattering of neutrons were calculated within the framework of a one-velocity "first collision" approximation. Cylindrical samples of thickness $\Sigma t \leq 0.25$ in a broad plane-parallel neutron flux were assumed. (tr-auth)

21009 (IAE-2137) CHECK OF THE NEUTRON DIFFUSION THEORY IN A MEDIUM WITH CHANNELS BY PULSE TECHNIQUES (CHANNEL LATTICE OF LARGE CROSS SECTION). Zhezherun, I. F.; Laletin, N. I. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 28p. (In Russian). INIS.

The diffusion of thermal neutrons was studied by the pulse method in several anisotropic media, representing square lattices of vacant channels of square cross section in Be and BeO. The lateral dimensions were greater than the transport length in a uniform substance. During the determination of the diffusion coefficients from the experimentally measured decrements of neutron attenuation, in blocks of various sizes, corrections were introduced for the channel length. The values obtained for longitudinal and lateral diffusion coefficients agree with the theoretical. (tr-auth)

21010 (RT/FI-(72)27) UTOE: AN UKNDL TO ENDF/B TRANSLATION PROGRAMME. Panini, G. C. (Comitato Nazionale Per l'Energia Nucleare, Bologna (Italy). Centro di Calcolo). 12 Jul 1972. 58p. Dep. NTIS (U. S. Sales Only).

UTOE (UKNDL to ENDF/B) is a program written in FORTRAN IV which performs the automatic translation of evaluated nuclear data from UK into ENDF/B format. Secondary energy distribution laws are treated in an approximate way. Care is taken in order to avoid any machine-dependent feature in the program.

21011 (RT/FI-(72)32) CHANDRASEKHAR'S H-FUNCTIONS AND ANGULAR FLUX DISTRIBUTIONS FOR TRANSPORT PROBLEMS WITH ANISOTROPIC SCATTERING. Bittoni, E.; Casadei, G.; Lorenzutta, S.; Trombetti, T. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 2 Aug 1972. 17p. (CONF-700578-3). Dep. NTIS (U. S. Sales Only).

Some theoretical results for neutron and radiation transport are combined with a constructive method of solution of Chandrasekhar's H equation. The order of scattering anisotropy is not restricted, and its influence on important physical quantities is determined and illustrated by numerical results. (5 figures, 8 tables) (auth)

21012 (RT/FI-(72)33) SOLUTIONS TO THE MONOENERGETIC NEUTRON TRANSPORT EQUATION. Boffi, V. C. (Comitato Nazionale Per l'Energia Nucleare, Rome (Italy)). 2 Aug 1972. 21p. (CONF-700578-4). Dep. NTIS (U. S. Sales Only).

This introductory speech to Session 1 of the 2nd Polish–Italian Seminar on Reactor Physics (May 1970) reports on the work which is in progress at CNEN's Bologna Centre in the field of neutron transport theory. (1 table) (auth)

21013 (RF/FT-(72)34) TRANSPORT THEORY OF MONOENERGETIC NEUTRONS IN FINITE CONVEX BODIES. Boffi, V. C.; Molinari, V. G.; Premuda, F.; Trombetti, T. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 2 Aug 1972. 23p. (CONF-700578-2). Dep. NTIS (U. S. Sales Only).

Solutions to the integro-differential form of the Boltzmann equation governing the flux distribution of monoenergetic neutrons at the boundary and in the interior of finite convex bodies are presented. The geometries investigated are a sphere of radius R, a cylinder of radius R and height 2H, and a rectangular parallelepiped of dimension $2a_i$ along the x_i direction ($i = 1,2,3$). The scattering is taken to be spherically symmetric in the lab-

oratory system. Both critical and subcritical conditions are considered. In the latter case a point δ-like isotropic source of unit strength is located at the center of the body. This center is in turn chosen to coincide with the origin of the coordinate system. As the body is assumed to be surrounded by a purely absorbing infinite medium, whose macroscopic absorption cross section is taken to be equal to the total macroscopic absorption cross section of the material composing the body, the method of the three-dimensional Fourier transform applies. A linear integral equation for the Fourier transform of the total flux is derived and solved by exploiting the properties of the linear integral transformation associated with its kernel. The solution of such a linear integral equation is then inverted to yield the desired result for both the total and the angular fluxes. (auth)

21014 (RT/FIMA-(72)6) PROGRAM FOR CALCULATION OF THE DIFFUSION-TRANSPORT COUPLING CONSTANT. Bitelli, G.; Torelli, L. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 19 Apr 1972. 21p. (In Italian). Dep. NTIS (U. S. Sales Only).

Given a two-dimensional map of calculated fluxes, the FORCA program (for particular geometry) calculates part of the macroscopic constants which, inserted in a diffusive code, generates those fluxes. The applications of the FORCA program can be multiple. (3 figures, 3 tables) (JSR)

21015 (UCRL-74277(Rev. 1)) CALCULATIONAL MODELS FOR LLL PULSED SPHERES. Plechaty, E. F. (California Univ., Livermore. Lawrence Livermore Lab.). 19 Jan 1973. 25p. (CONF-721117-2). Dep. NTIS.

From Cross Section Evaluation Working Group Meeting; Upton, New York, United States of America (USA) (8 May 1972).

Calculational models for LLL pulsed spheres are presented, together with a discussion of the effects of simplifications. Data relevant to detector response functions, pertinent geometric configurations, and all other information required to calculate time spectra of detected neutrons are included. (2 figures, 3 tables) (auth)

21016 GROUP THEORY OF BINARY VECTORS OF TWO-GROUP DIFFUSION EQUATIONS. Ledinegg, E. (Technische Hochschule, Graz). Acta Phys. Austr.; 33: No. 3-4, 231-42 (1971). (In German).

The transformation behavior of the neutron flux vector is studied on the basis of the well-known matrix representation of diffusion equations that belong to n energy groups; the components of the vector are determined by the neutron flux of each group. That matrix must be chosen as transformation group which is interchangeable with the system of diffusion equations. The ensuing computation is done particularly for the example of the binary vectors of the two-group diffusion theory. Based on group theory, certain information is gained about the structure of binary series expansion. (tr-auth)

21017 DETERMINATION OF FLUX DISTRIBUTIONS IN A CYLINDRICAL TWO-LAYER CONFIGURATION WITH PLANE SOURCES IN TWO-GROUP DIFFUSION THEORY. Haring, Guenter (Technische Hochschule, Graz). Acta Phys. Austr.; 33: No. 3-4, 333-48(1971). (In German).

Neutron flux distributions are calculated for a cylindrical two-layer configuration in the framework of the two-group diffusion theory. In this system the triggering of the neutron flux occurs through a flat plane source of fast neutrons, the plane of which lies perpendicular to the cylinder axis. The solution of the problem takes into account special relations of orthogonality throughout the entire space considered and is presented explicitly. To determine the flux distribution in the thermal velocity group, the common solution method must be expanded in such a way as to yield sufficient degrees of freedom for meeting all boundary and transition conditions. (1 figure) (tr-auth)

21018 EMISSION OF ULTRACOLD NEUTRONS FROM MODERATORS. Golikov, V. V.; Lushchikov, V. I.; Shapiro, F. L. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz.; 64: No. 1, 73-81(Jan 1973). (In Russian).

The yields of ultra-cold neutrons (UCN) from various thin convertor plates possessing a temperature T_c and irradiated by an isotropic beam of thermal neutrons with a Maxwellian spectrum and a temperature T_n are calculated. It is shown that for a number of substances (polyethylene, zirconium hydride, beryllium etc.) the UCN yield for a fixed neutron spectrum temperature T_n considerably increases on cooling of the convertor. On the other hand the UCN yield for aluminum and magnesium only weakly depends on the convertor temperature T_c. This is due to the relatively small magnitude of the neutron heating cross section compared to the capture cross section for these substances. It is concluded that for extraction of very slow neutrons from the thin layer of the moderator surface layer it should be sufficient to cool only the surface layer or the convertor but not the moderator as a whole. The calculations are verified experimentally for the UCN channel of the IBR-30 pulsed reactor. The experimental UCN yields measured for various convertors are in agreement with the calculations. Cooling of polyethylene or zirconium hydride convertors from room temperature down to 130 and 90°K resulted in an increase of the UCN beam which was somewhat smaller than that predicted by the calculations. (auth)

21019 NEUTRON TRANSPORT EQUATIONS WITH SPIN-ORBIT COUPLING. Tannenwald, L. M. (Univ. of California, Berkeley). J. Math. Phys. (N. Y.); 14: No. 1, 97-101(Jan 1973).

An ab initio derivation of the transport equations is given for fast neutrons traversing a material having spin zero nuclei. The resulting set of equations agrees with the equations of Bell and Goad except for the treatment of the coherent terms. Application of the equations to asymmetric situations is suggested. (auth)

21020 INTERACTIVE GRAPHICAL COMPUTING FOR SIMULATING AND UNFOLDING MEASURED DISTRIBUTIONS. Routti, J. T. (CERN, Geneva). Comput. Phys. Commun.; 4: No. 1, 33-39(Oct 1972).

Techniques for the simulation and solution of the unfolding problem are described. The mathematical formalisms employed permit the use of a priori information of the solution to improve the stability and the uniqueness of the solution. In the computation graphical interaction with an on-line terminal is used. The methods are illustrated by considering examples of neutron spectroscopy with activation detectors. (auth)

21021 RETHERMALIZATION OF NEUTRONS IN GRAPHITE-BISMUTH SYSTEMS. Bhushan, V. (Safdarjang Hospital, New Delhi). J. Nucl. Energy; 26: No. 12, 593-604(Dec 1972).

Using plane geometry, with first block of media of finite thickness and the second block extending to infinity, the steady-state neutron spectra were calculated at different space points in fourteen different systems of graphite-bismuth which involved medium discontinuity at 500°K, 300°K and 100°K, temperature discontinuity in bismuth, and medium and temperature discontinuities together at the same time. The space variation of effective neutron temperature was studied from the calculated spectra. Starting from an equilibrium distribution in the first medium (of finite thickness) it was found that the equilibrium is disturbed as the interface is approached and in the second medium it is only at some distance from the interface that equilibrium is again re-established. Diffusion lengths of neutrons in graphite and bismuth at 500°K, 300°K and 100°K are also reported. (auth)

21022 SPACE HARMONICS IN PULSED NEUTRON EXPERIMENTS. Hanna, Nabil N.; El-Kady, Ahmed (Atomic Energy Establishment, Cairo). Atomkernenergie; 20: No. 1, 90(Sep 1972).

A harmonic analysis modification that reduces the number of necessary neutron density measurements in determining the spatial distribution of the asymptotic energy spectrum in a parallelepiped in pulsed neutron experiments is outlined. (LTW)

21023 ANALYSIS OF PULSED NEUTRON EXPERIMENT IN BERYLLIUM BY THE METHOD OF INELASTIC SCATTERING EXPANSION. Matsumoto, T. (Kyoto Univ., Osaka). J. Nucl. Sci. Technol. (Tokyo); 9: No. 8, 453-64(Aug 1972).

Pulsed neutron experiments in beryllium were analyzed by the method of inelastic scattering expansion. Considering the full range of energy, the present method is applied to the calculation of the time-dependent spectra within a system as well as at its surface. For obtaining the decay curve of the neutron counting rate, the neutrons are classified according to the number of specified inelastic scatterings that scatter the neutrons over the Bragg cutoff energy. The pseudo mode is, as a principal result, shown to correspond to an eigen solution of the thermal bounded equation. The buckling dependence of the eigenvalue and the eigen spectrum of the thermal bounded equation are studied, and useful approximate expressions are derived. The calculated results are compared with the experiments by Fullwood et al. and other authors. (auth)

21024 APPLICATION OF ADAMS' METHOD TO NEUTRON MODERATION IN AN INFINITE HOMOGENEOUS MEDIUM. Platonov, A. P. Zh. Vychisl. Mat. i Mat. Fiz.; 12: No. 5, 1325-1331(1972). (In Russian).

Adams' method was utilized for a numerical solution to the problem of slowing down of neutrons in an infinite, homogeneous, one-component medium. This method facilitates the use of reference formulas with considerable accuracy (0.01%) for approximation integration of set problems. (tr-auth)

21025 ANIZOTROPIYA UPRUGOGO RASSEYANIYA NEITRONOV. (Anisotropy of Elastic Scattering of Neutrons).

Nikolaev, M. N.; Bazazyants, N. O. Moscow; Atomizdat (1972). 237p.

A survey of published data on the angular distributions of elastically scattered neutrons is presented in the form of graphs depicting the energy spectrum to 15 MeV. The series of graphs begins with $^{2}_{1}D$ and ends with $^{239}_{94}Pu$. A discussion of experimental methods is included. Twenty-five references are included plus an appendix of approximately 180 citations from the literature in connection with the experimental data. (KSW)

21026 SOME PROBLEMS IN NEUTRON TRANSPORT THEORY SOLVED BY A GENERALIZED METHOD OF EIGENFUNCTIONS. Gorelov, V. P.; Il'in, V. I.; Yuferev, V. I. Zh. Vychisl. Mat. i Mat. Fiz.; 12: No. 5, 1245-1264(1972). (In Russian).

A solution for neutron transport equations was obtained by Keyes' method allowing for energy dependence and anisotropic scattering in plane and spherical geometries. The solution found may be used for determining the critical parameters of systems of fissile materials and for deriving neutron spectra in a slab irradiated outside a neutron flux. A degenerate nucleus of collisions was used in a problem with energy dependence, which leads to a partial algebraic problem. (tr-auth)

21027 j_N METHOD FOR NEUTRON TRANSPORT PROBLEMS IN MULTILAYER SLAB SYSTEMS AND ITS APPLICATION TO THE OPTIMIZATION OF MODERATORS IN PULSED REACTORS. Asaoka, T.; Bonanni, E. C. (Joint Nuclear Research Center, Ispra, Italy). J. Nucl. Energy; 26: No. 12, 605-625(Dec 1972).

The newly developed j_N method has been further extended to deal with multilayer slab systems with anisotropic scattering of neutrons. The complete mathematical formalism for space-angle energy-time dependent neutron transport in slab geometry is given. The time moments of the neutron flux resulting from the incidence of an external delta function source can also be obtained in a simple analytical form similar to the stationary flux and calculated easily with a reasonable accuracy. By the use of this theory, an optimization study of moderators installed in pulsed reactors or accelerator pulsed reactors is carried out with respect to the heterogeneous poisoning. The thermal neutron yield leaking from a water slab and the variance of the leakage time distribution are obtained. The results have shown that heterogeneous poisoning can give a gain in the figure-of-merit for accelerator pulsed reactors by a factor of more than 3 compared to the unpoisoned value. (auth)

21028 COMPARISON OF THE ANISOTROPIC DIFFUSION COEFFICIENTS BASED ON THE BENOIST AND DENIZ FORMULAS. Takeda, Toshikazu; Sekiya, Tamotsu (Osaka Univ.). J. Nucl. Sci. Technol. (Tokyo); 9: No. 11, 682-5(Nov 1972).

The perpendicular neutron diffusion coefficient in slab cells is evaluated using the formulas of Benoist and Deniz in the time-dependent problem. The difference in the values of the diffusion coefficient obtained by the two methods is then examined. (LTW)

21029 GREEN'S FUNCTION APPROACH TO ANISOTROPIC MULTIGROUP VELOCITY IN PLANE GEOMETRY. El Wakil, S. A. (Atomic Energy Establishment, Cairo). Atomkernenergie; 20: No. 2, 115-16(Oct 1972).

The Green's function approach is used to obtain the solution of the anisotropic multigroup transport equation for plane geometry. The result is used to obtain the reflection and transmission coefficients on the basis of previous work. (auth)

21030 REPLY TO COMMENTS ON VARIATION FLUX SYNTHESIS METHODS FOR MULTIGROUP DIFFUSION THEORY. Stacey, W. M. Jr. (Argonne National Lab., Ill.). Nucl. Sci. Eng.; 49: No. 1, 114-15(Sep 1972).

21031 COMMENTS ON VARIATION FLUX SYNTHESIS METHODS FOR MULTIGROUP DIFFUSION THEORY. Buslik, A. J. (Bettis Atomic Power Lab., West Mifflin, Pa.). Nucl. Sci. Eng.; 49: No. 1, 112-14(Sep 1972).

21032 IMPROVED INTEGRAL TRANSPORT THEORY BY MEANS OF SPACE POLYNOMIAL APPROXIMATIONS. Ligou, J. (Swiss Federal Inst. for Reactor Research, Wuerenlingen). Nucl. Sci. Eng.; 50: No. 2, 135-146(Feb 1973).

Polynomial approximations in space are used for solving the integral transport equations for multilayers systems, in one dimensional spherical or cylindrical geometry with scattering anisotropy. These polynomial approximations are applied to the neutron sources (collided neutrons) in each layer, in such a way that the mean quadratic error is a minimum. The form of this approximation allows a less complicated treatment of the anisotropic components of the collided neutron sources than the usual approach (collision probabilities for uniform sources). In order to reduce the number of necessary integral equations when the scattering anisotropy is present, some differential equations relating the spherical harmonics components of the angular flux are used. This is very useful from a numerical point of view, especially when polynomial approximations in space are introduced. A very important link between the scattering anisotropy and the degree of polynomial approximations is also derived. Based on this method the SHADOK code was written. Several numerical examples dealing with multigroup calculations of fast critical assemblies for spherical geometry (FRO-GODIVA-TOPSY-ZPR.43/8) are given. The results show that (a) the large optical dimensions are not a problem for this improved integral method, (b) the scattering anisotropy (at least P1) does not increase the time of computation, and (c) the heterogeneous systems (reflected cores) can be calculated easily. The calculations with the proposed method are considerably faster than those of the S_N method. (auth)

21033 NEUTRON SLOWING DOWN WITH INELASTIC SCATTERING. Lineberry, M. J. Pasadena, CA; California Inst. of Tech. (1972). 126p. University Microfilms Order No. 72-30,815. Thesis.

The emphasis in reactor physics research has shifted toward investigations of fast reactors. The effects of high energy neutron processes have thus become fundamental to understanding, and one of the most important of these processes is nuclear inelastic scattering. Inelastic scattering as a primary energy transfer mechanism, and the resultant neutron energy spectrum in an infinite medium are studied. The moderator material is assumed to have a high mass number, so that in a laboratory coordinate system the energy loss of an inelastically scattered neutron may be taken as discrete. It is then consistent to treat elastic scattering with an age theory expansion. Mathematically these assumptions lead to balance equations of the differential-difference type. The steady state problem is explored first by way of Laplace transformation of the energy variable. Another steady state technique, valid for multiple inelastic level excitations is developed, which depends on the level structure satisfying a physically reasonable constraint. In all cases the solutions are compared with results obtained by modeling inelastic scattering with a separable evaporative kernel. The time dependent problem presents some new difficulties. By modeling the elastic scattering cross section in a particular way, solutions to this more interesting problem are generated. The method of characteristics may be useful in analyzing time dependent problems with general cross sections. These ideas are briefly explored. (Diss. Abstr. Int., B)

21034 EXACT COLLISION PROBABILITIES FOR SPHERICAL SHELLS IN A HOMOGENEOUS MEDIUM. Leifert, T. (Research Inst. of National Defense, Stockholm). Nucl. Sci. Eng.; 49: No. 4, 507-9(Dec 1972).

Exact analytical expressions are derived for the elements of the first flight collision probability matrix in a homogeneous medium subdivided into concentric, spherical shell subregions. (auth)

21035 SPHERICAL HARMONIC SOLUTIONS OF THE NEUTRON TRANSPORT EQUATION FROM DISCRETE ORDINATE CODES. Reed, Wm. H. (Los Alamos Scientific Lab., N. Mex.). Nucl. Sci. Eng.; 49: No. 1, 10-19(Sep 1972).

A method for obtaining spherical harmonic or P_L solutions of the transport equation from discrete ordinate or S_N codes is developed in this paper. This method depends on a new interpretation of the S_N method as a projection method. The technique of converting S_N solutions into spherical harmonic solutions is discussed in detail for x-y geometry, and numerical results are presented. The method of this paper differs from earlier methods in that S_N solutions can be converted to P_{N-1} solutions. (auth)

21036 DISCRETE ORDINATE NEUTRON TRANSPORT EQUATION EQUIVALENT TO P_L APPROXIMATION. Jung, Jungchung; Chijiwa, Hiroshi; Kobayashi, Keisuke; Nishihara, Hiroshi (Kyoto Univ.). Nucl. Sci. Eng.; 49: No. 1, 1-9(Sep 1972).

A discrete ordinate transport equation in two dimensions equivalent to the P_L approximation is derived to eliminate the ray effect in the ordinary discrete ordinate equations. The number of the discrete ordinates, or the number of unknown functions of this discrete ordinate equation, is equal to that of the P_L equations. Since it is also possible to obtain boundary conditions equivalent to those of the P_L approximation at the interface of mediums or at the free surface, a solution identical to that of the P_L equation can be obtained. (auth)

21037 TWO OVERLAPPING-GROUP TRANSPORT COMPUTATIONAL METHOD FOR THERMAL NEUTRON PROBLEMS. Natelson, M.; Gelbard, E. M. (Westinghouse Electric Corp., West Mifflin, Pa.). Nucl. Sci. Eng.; 49: No. 2, 202-12(Oct 1972).

A method for solving the energy-dependent thermal neutron transport equation in X-Y geometry is described. Two variants

of this method have been developed. In the first variant the flux over the whole thermal energy range is treated by the Buslik overlapping group technique. The trial function is of a form first introduced by Lancefield, involving two space-angle functions each multiplied by a trial spectrum. The space-angle functions are computed by solving two coupled transport equations, using S_N or P_N methods. Numerical experiments show that this first approach is not always adequate and that a more complicated, second variant must, sometimes, be used instead. In this second variant the thermal range is split into two bands. The upper band is treated as one neutron group, while the two-overlapping group method is applied in the lower band. Experience indicates that, even when the first method is inadequate, the second is accurate enough for most analysis work. (auth)

21038 EFFECT OF SINGULARITIES ON APPROXIMATION IN S_N METHODS. Arkuszewski, Jacek; Kulikowska, Teresa; Mika, Janusz (Inst. of Nuclear Research, Swierk, Poland). Nucl. Sci. Eng.; 49: No. 1, 20-6(Sep 1972).

The discrete ordinate transport equation in two-dimensional rectangular geometry is analyzed. The exact solution is shown to exhibit singularities at the so-called singular characteristic, even for arbitrarily smooth cross section, source, and external boundary conditions. The Box Explicit Method is proposed and used to numerically investigate the effect of the angular characteristic. (auth)

21039 COMPUTER SOLUTIONS OF SOME TRANSPORT PHENOMENA PROBLEMS. Schot, J. W. (Naval Ship Research and Development Center, Bethesda, MD). Comput. Phys. Commun.; 4: No. 1, 73-81(Oct 1972).

Advances in digital computer methods for solving two types of three-dimensional boundary value problems are described. Early work in calculating the diffusion of neutrons in nuclear reactors led to sophisticated computer programs for predicting the lifetime behavior of proposed reactor cores. Experience gained with these reactor simulation methods, coupled with improvements in computer technology, make it possible to attack the nonlinear boundary value problems of viscous fluid motion. Several recently developed programs for studying rotating viscous fluids and the behavior of fluids moving past obstacles of different shapes are discussed. (auth)

21040 NEUTRON MIRAGE FORMATION. Bates, J. C. (Universities Research Reactor, Warrington, Eng.). Nucl. Instrum. Methods; 106: No. 3, 611(1973).

There appears to be a close analogy between neutron reflection from a ground surface and the optical mirage. (1 figure) (auth)

21041 POSSIBILITY OF STORING ULTRACOLD NEUTRONS. Presman, V. S.; Karimov, I. (Inst. of Nuclear Physics, Kiev). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz. Mat. Nauk; No. 5, 43-45(1972). (In Russian).

The question of raising the density of ultracold neutron fluxes i.e., those where the initial "temperature" of the neutrons may be in the neighborhood of 60°K, was explored. Kinetic equations of neutron distributions, containing terms which described neutron atom collisions, the density of the "filler" material, and the differential cross section for neutron scattering by the "filler" material, were manipulated and applied to the practical problem of the neutron behavior in a copper cavity filled with O_2 or H_2. (KSW)

21042 MULTIGROUP CROSS-SECTIONS FOR FAST REACTOR CALCULATIONS. Cuculeanu, V. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 24: No. 9, 1128-1138(1972). (In Rumanian).

Calculation and weighting methods for multigroup cross sections used in fast reactor calculations are reviewed. The weighting of transport cross sections and elastic and inelastic transfer calculations are discussed. (LTW)

21043 ASYMPTOTIC NEUTRON SPECTRUM AND THE EFFECT OF FICTITIOUS ABSORPTION. Gorelov, V. P.; Malinovskaya, E. V.; Yuferev, V. I. This paper was summarized in At. Energ. (USSR); 31: No. 6, 620(Dec 1971) as paper No. 544/6407. (In Russian).

Full copy of this paper is held by TIC.

The operator form of the neutron transport equation is solved, assuming that the reaction cross sections are velocity-independent. Single-group constants (in barns) were obtained using asymptotic neutron energy spectra for ^{235}U, ^{238}U, and ^{239}Pu at five different cross sections. Cross section ratios σ_i/σ_f^{239} and σ_i/σ_f^{238} were calculated for the three reactions $^{235}U(n,f)$, $^{238}U(n,f)$, and $^{238}U(n,\gamma)$. (LTW)

21044 DECAY OF A THERMALIZED NEUTRON-PULSE IN SPHERICAL LIGHT WATER SYSTEMS. Nassar, S. F. (Atomic Energy Authority, Cairo). Atomkernenergie; 20: No. 2, 111-14 (Oct 1972).

A study of neutron thermalization in spherical light water systems was carried out using the P_1-L_1 method. Various values of the thermalization parameter M_2 corresponding to various scattering kernels were employed. A value of $M_2 = 0.67$ cm^{-1} gave calculated values of the fundamental decay constant λ_0 in excellent agreement with experiment. This decay constant was expressed in terms of a new space variable B_T^2, that differs from the conventional geometric buckling B^2 in the same way as the P_1 differs from the diffusion approximation in the time dependent problems. Available experimental data were fitted to $\lambda_0 = f(B_T^2)$ and $\lambda_0 = f(B^2)$. Diffusion parameters obtained from the first fit had improved standard deviations when compared with those obtained from the second fit. Thermalization time constant, space, and energy transients were also investigated. (auth)

21045 NEUTRON TRANSPORT FOR A SLAB WITH A DEGENERATE SCATTERING KERNEL. Larson, H. A.; McCormick, N. J. (Univ. of Washington, Seattle). Nucl. Sci. Eng.; 50: No. 1, 10-19(Jan 1973).

Solutions for collision densities in a slab with an energy- and angle-dependent degenerate scattering kernel are developed. The slab distribution is expanded in a set of regular and singular eigenfunctions, and the expansion coefficients are obtained as solutions of a matrix integral equation. From invariance principles, this integral equation depends upon the half-space generalized Milne solution. To obtain this solution one must solve a nonlinear matrix equation for a generalization of the Chandrasekhar H function. Approximate solutions and numerical calculations for the heavy-gas scatterer are presented, including emergent distributions for the slab. (5 figures, 5 tables) (auth)

21046 SOLUTION OF THE TRANSPORT INTEGRAL EQUATION WITH ANISOTROPIC SCATTERING. Hembd, H. (CCR, Ispra, Italy); Kschwendt, H. J. Comput. Phys.; 10: No. 3, 534-553(Dec 1972).

The solution of the integral equation for particle transport in homogeneous material systems having plane and spherical symmetry is considered. Emphasis is put on the explicit inclusion of anisotropic scattering (higher Legendre components of the scattering kernel). The present approach is based on a generalization of the integral transform method. The solution is represented as an expansion with respect to analytical basis functions with coefficients satisfying a certain linear system. The determination of this linear system and its matrix elements in a form convenient for numerical purposes is the central point of the paper. For the computation of the matrix elements a computer program has been developed. It calculates the elements in the case of isotropic and linear anisotropic scattering in systems of plane and spherical symmetry as a function of the optical thickness of the system. Higher anisotropy is easily included. Numerical examples indicate the great practical importance of the method, due to the fact that the computational effort involved is very low, especially for small systems. (auth)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 19922, 20867, 20937, 21007, 21050, 21058, 21070, 21110, and 21224.

21047 (JINR-E2-6890) AMBIGUITIES IN π^4He PHASE SHIFT ANALYSIS. Nikitiu, F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 10p. Dep. NTIS (U. S. Sales Only).

For the practical case of scattering of zero spin on zero spin ($\pi^{\pm4}$He – $\pi^{\pm4}$He) only two solutions have been found (in the energy range 24 to 153 MeV). The scattering amplitude has two zeros in complex cosθ plane. The first zero is in the upper half plane for solution I hand in the lower half plane for solution II, and its position is dependent on total cross section. For both solutions the second zero is roughly in the same position and is independent on total cross section. (auth)

21048 SOME REMARKS ON THE NELKIN MODEL FOR NEUTRON SCATTERING IN WATER. Markovic, M. I. (Univ., Belgrade). Nucl. Instrum. Methods; 106: No. 3, 519-524(1973).

The influence of the number of terms in the Nelkin model on the differential and total scattering cross sections is investigated, and an expression for the scattering kernel simpler than Nelkin's is developed. An approximate relation for determining the cutoff energy for neutron upscattering is also proposed. (1 figure, 5 tables) (auth)

21049 ELECTRODISINTEGRATION OF THE DEUTERON BY 4 TO 11 MeV ELECTRONS. Phenneger, M. C. Jr. Williamsburg, VA; Coll. of William and Mary (1972). 107p. University Microfilms Order No. 72-24,059.

Thesis.

In order to investigate the nuclear matrix elements for disintegration and to test the theory of virtual photons, a comparison measurement between low energy electrodisintegration and low energy photodisintegration of the deuteron was made. The differences between the photonuclear and electronuclear interactions arise through the longitudinal electric coupling of the electron, allowing the nuclear monopole transition, and from the fact that the electron momentum transfer is not determined by its energy transfer. The virtual photon theory is the commonly used theoretical description of the electroexcitation process for the low-energy region. The ratio of the neutron yield from deuteron photodisintegration to the neutron yield from deuteron electrodisintegration was measured. The photon beam was a bremsstrahlung beam from electrons converted in an 89.5 mg/cm^2 copper foil. The range of electron beam energies was 4 to 11 MeV. The experimental results agree with the theoretical results using a Hulthen (no core) deuteron wave function normalized to 6.5% D-state and free final waves for all L > 0. The theoretical result is shown to be the same if one uses the Reid soft core deuteron wave function with phase shifted final waves. The experimental accuracy for the ratio of the photodisintegration to the electrodisintegration yield is 4% at 10 MeV and 9% at 4 MeV. The agreement of experiment with theory verifies that within the experimental accuracy for this range of electron energies, the electrodisintegration and photodisintegration cross sections are determined by essentially the same nuclear matrix elements and that the virtual photon theory of electrodisintegration is adequate. (Diss. Abstr. Int., B)

21050 ANGULAR DISTRIBUTION OF D–D NEUTRONS IN ^{9}Be + d REACTION. Srivastava, M. L.; Sah, J. P. (Lucknow Univ., India). Indian J. Pure Appl. Phys.; 10: No. 7, 567(Jul 1972).

The neutrons produced from the D–D reaction were observed in the study of the ^{9}Be + d reaction using the photographic method. The angular distribution of these neutrons shows that the formation of ^{3}He in the ground state is due to a stripping process, and is well explained by Butler's theory. (1 figure) (auth)

21051 n–p FINAL STATE INTERACTION IN THE REACTIONS ^{2}H(d,pn)^{2}H, ^{4}He(d,pn)^{4}He, ^{6}Li(d,pn)^{6}Li, AND ^{3}He(d,pn)^{3}He. Chemarin, M.; Burq, J. P.; Cabrillat, J. C.; Ille, B. (Univ., Lyon). Nucl. Phys. A202: No. 1, 71-82(1973). (In French).

Three-body break-up in n–p final-state-interaction regions was investigated through the reactions ^{2}H + d → p + n + ^{2}H, ^{4}He + d → p + n + ^{4}He, ^{6}Li + d → p + n + ^{6}Li, and ^{3}He + d → p + n + ^{3}He. In all cases, the proton and the neutron were detected at the same angle in a kinematically complete experiment for a deuteron bombarding energy of 27.5 MeV. Helium and deuterium gas targets in a small gas cell cooled with liquid nitrogen were used. No indication of any possible contribution from the (isospin-forbidden) $^1S_0$ p–n final-state interaction was observed in the first three reactions. For the ^{3}He + d reaction, the data shown pronounced enhancements due to the p–n final-state interaction. In the forward regions the observed peaks are broader than the predictions of final-state-interaction models. (auth)

21052 STUDY OF EXCITED STATES OF ^{8}Be AND ^{5}He BY A COINCIDENCE METHOD. Strauss, Loetz. Pretoria; Pretoria Univ. (1972). 70p. (In Afrikaans). Atomic Energy Board, Pretoria.

Thesis.

The 4$^+$ second excited state of ^{8}Be was studied. The penetration coefficients for the formation and decay channels were used to calculate the reduced width and the position of the level E_r = 12.2 ± 0.4 MeV, γ^2 = 0.68 ± 0.09 MeV. The position was found to be ~0.8 MeV above the generally accepted value. A method was devised for the analysis of dual-parameter coincidence spectra of the ^{7}Li + d reaction, and two excited states of ^{5}He were seen (E_r = 2.9 ± 0.1 MeV, γ^2 = 1.07 ± 0.42 MeV and E_r = 4.8 ± 0.4 MeV, γ^2 = 0.90 ± 0.43 MeV). The higher level has not been observed before. A search program was written by which estimated values of the level parameters could be optimized. The program proved successful even for a case in which the optimum values of ten parameters for one spectrum had to be calculated. (LTW)

21053 STRUCTURE OF ^{4}He AND PHASE-SHIFT EQUIVALENT POTENTIALS. Burr, W.; Schuette, D. (Univ., Bonn). Nucl. Phys.; A202: No. 1, 83-96(1973).

The Hartree–Fock and Brueckner theories are applied to the nucleus ^{4}He. A truncated finite space of single-particle oscillator states is used, and different choices of the particle spectrum in Brueckner theory are considered. Results for the total binding energies and wound integrals are presented for the Reid soft-core potential and sets of phase-shift equivalent potentials generated from the Reid potential by a rank-one unitary transformation. The relation of the results to the position of the Emery singularities is investigated. (8 figures, 2 tables) (auth)

21054 NEUTRON POLARIZATION FROM THE D(d,n)^{3}He REACTION AND ANALYZING POWERS OF T(p,d)D AND T(p,p)T. Hardekopf, R. A. Durham, NC; Duke Univ. (1972). 128p. University Microfilms Order No. 72-23,232.

Thesis.

The neutron polarization from the D(d,n)^{3}He reaction was measured at 45 degrees c.m. for incident deuteron energies between 16 and 22 MeV. In addition, a polarization angular distribution was measured at 18 MeV. The results show that the 45 degree c.m. polarization remains above 0.35 in this energy range, but the peak polarization has shifted to near 40 degrees c.m. The usefulness of D(d,n)^{3}He as a source of 16 to 22 MeV polarized neutrons is discussed. Accurate angular distributions of the analyzing power in the T(p,d)D reaction were measured at eight energies from 6.7 to 14.7 MeV. By reciprocity, these distributions are the same as the proton polarizations of the D(d,p)T reaction from 2.0 to 14.0 MeV. Comparisons are made with the polarizations from the mirror reaction D(d,n)^{3}He, and good agreement is found when the reactions are compared at the same exit channel energies. The implications of this are discussed in the light of other recent comparisons which suggest that differences in these mirror reactions may be a violation of charge independence of nuclear forces. Very accurate polarizations in T(p,p)T elastic scattering were obtained in conjunction with the T(p,d)D measurements. Single energy complex phase shift parameterizations were made at five energies from 9.4 to 14.7 MeV. No resonance structure was seen for any of the phase shifts in this energy range. (Diss. Abstr. Int., B)

21055 CHARGE-EXCHANGE AND/OR KNOCKOUT SPECTATOR POLES IN THE D(^{3}He,tp)p REACTION. Warner, R. E.; Ball, G. C.; Davies, W. G.; Ferguson, A. J.; Forster, J. S. (Chalk River Nuclear Labs., Ont.). pp 360-364 of Two-body force in nuclei. Austin, S. M. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on the Two-Body Force in Nuclei; Ann Arbor, Michigan, United States of America (USA) (7 Sep 1971). See CONF-710915–.

A CD_2 target was bombarded by 27-MeV $^3H^{2+}$ ions, and coincidence cross sections (absolute) were measured as a function of ^{3}He and t laboratory energies for ^{2}H(^{3}He,tp)p and ^{2}H(^{3}He,^{3}Hep)n reactions. Intense spectator peaks resulting from quasi-elastic scattering accompanied by charge exchange were observed. A plane-wave Born-approximation analysis of the data was carried out. This work provides additional evidence for the existence and strength of charge exchange. The most striking failures of the model are its inability to give a proper account of the strength of the knockout process and, even if only charge exchange takes place, the unrealistic exchange force required to give the observed (t + p + p)/(^{3}He + p + n) cross-section ratio. (3 figures) (RWR)

21056 RELATIVISTIC CORRECTIONS TO ELECTRON SCATTERING BY THE DEUTERON AND TRITON. Friar, J. L. (Massachusetts Inst. of Tech., Cambridge). Contract AT(11-1)-3069. Phys. Lett.; 43B: No. 2, 108-112(22 Jan 1973).

Relativistic corrections to electron–deuteron and electron–^{3}He scattering were calculated. The deuteron corrections agree substantially with the results of Gross, and the ^{3}He corrections are approximately equal in magnitude to those of Cocho and Flores. (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 20789, 21048, 21050–21052, 21076, 21085, 21105, 21119, 21120, 21169, 21177, 21178, 21217, 21233, 21236, 21237, and 21239.

21057 (FOA-4-4492-A-2) GAMMA-RAYS FROM NEUTRON INDUCED REACTIONS IN NITROGEN. Nystroem, G.; Conde, H.; Lundberg, B.; Stroemberg, L. G. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). May 1972. 34p. Dep. NTIS (U. S. Sales Only).

The gamma-ray production cross sections of nitrogen have been measured at three different incident neutron energies, 4.2, 5.9, and 6.9 MeV. The gamma-ray spectrometer was a Ge(Li) detector. Time-of-flight techniques were employed to suppress the background caused by neutron interactions in the Ge(Li) detector. The

efficiency of the gamma-ray spectrometer was measured with calibrated gamma-ray sources and (p,γ) reactions. The primary neutron flux was measured with a proton-recoil telescope. Differential gamma-ray production cross sections at 55° are given. The angular distributions of the gamma rays were measured at E_n = 6.9 MeV between 40° and 140°. The results were compared with calculated distributions obtained with a statistical compound-nucleus theory. The lifetimes of the six lowest excited states in ^{14}N could be estimated from the observed Doppler shifts in the angular distribution measurement. (auth)

21058 (UCRL-51310) NEUTRONS FROM DEUTERON BOMBARDMENT OF LIGHT NUCLEI. Weaver, K. A. (California Univ., Livermore. Lawrence Livermore Lab.). 7 Dec 1972. Contract W-7405-eng-48. 82p. Dep. NTIS.

Thesis.

Energy spectra of neutrons from deuteron bombardment of thick Be, Li, and C targets were measured at 5 lab angles from 3.5° to 32.3° by neutron time-of-flight techniques. Also measured were spectra of neutrons from deuteron bombardment of thin D_2 and Be targets. Deuteron energies ranged from 3 to 19 MeV. Deuterons lost about 1 MeV in the thin Be targets and about 0.25 MeV in the D_2 target. The spectra were integrated to give absolute neutron yields or cross sections, and average neutron energies. For deuteron energies above 12 MeV, thick Be and Li produced approximately equal numbers of neutrons at 3.5°, while the 3.5° neutron yield from thick C was about two-thirds as great. For deuteron energies E_d > 12 MeV, cross sections for the D(d,np)D reaction were determined. The average energies of neutrons from thick Be, Li, and C targets were 0.38 E_d, 0.38 E_d, and 0.39 E_d, respectively, for E_d greater than 10 MeV. The average energy of neutrons from thin Be targets was about 0.5 E_d for E_d > 6 MeV. From thin-target data neutron yields and average energies were calculated for thicker Be and D_2 targets. Dose rates from several neutron sources were compared. This work was undertaken to investigate intense sources of fast neutrons. (33 figures, 4 tables) (auth)

21059 DISTORTION IN QUASI-FREE SCATTERING. Herscovitz, V. E.; Jacob, G.; Maris, T. A. J.; Schneider, C. (Rio Grande do Sul Univ., Brazil). Rev. Brasil. Fis.; 1: 43-53(Apr 1971).

Distorted momentum distributions of (p,2p) reactions with ^{16}O are calculated with a complex distorting potential consistent with the nucleon density distribution in the nucleus. A comparison with conventional calculations using an equivalent but "nonconsistent" potential shows considerable differences, in particular for the distorted momentum distribution of the 1s protons. Some more general aspects, important for the detailed interpretation of quasi-free experiments, are pointed out and briefly discussed. (auth)

21060 NUCLEAR STRIPPING PROCESS AND ITS ANALYSIS WITH THE HELP OF A DIFFRACTION PROCEDURE. Gonchar, V. Yu.; Yushkov, A. V. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 24-9(1972). (In Russian).

The angular distribution of 19-MeV proton groups was measured in a cyclotron for the reactions $^{90}Zr(d,p)^{91}Zr$ and $^{92}Mo(d,p)^{92}Mo$. The measurements were conducted in the center-of-mass system at angles of 10 to 53° with 2° steps using a semiconductor spectrometer. A theoretical analysis of angular distributions was made on the basis of diffraction theory of stripping. The optimal values were determined for the effective radii of deuteron interaction with the nuclei ^{12}C, ^{28}Si, ^{52}Cr, ^{90}Zr, and ^{92}Mo. Regularities were detected in the dependence on radii of interaction, on deuteron energy, orbital momentum of the captured neutron, and the reaction energy. (tr-auth)

21061 TOTAL STRAGGLING OF NEUTRONS FROM Li + D NUCLEAR REACTION IN ILFORD G5 NUCLEAR EMULSIONS. Saxena, M. K. (College of Military Engineering, Poona, India). Indian J. Phys.; 46: No. 2, 82-5(Feb 1972).

The straggling of neutrons was studied with the help of Li + d nuclear reaction, wherein the width of the half maximum for the peak of neutron distribution corresponding to formation of ^{9}Be in the ground state was analyzed. The experimental width obtained is about 400 keV, which is much larger than the theoretical estimate. The analysis reveals that the broadening of the peak is mainly due to straggling effects. (auth)

21062 $^{7}Li(p,n_0)^{7}Be$ ANGULAR DISTRIBUTIONS TO E_p = 3.8 MeV. Burke, C. A. Eugene, OR; Univ. of Oregon (1972). 115p. University Microfilms Order No. 72-28,122.

Thesis.

Discrepancies between results from earlier measurements of the $^{7}Li(p,n_0)^{7}Be$ differential cross section prevent use of the neutron spectrum from this reaction as a standard of intensity. Differential excitation curves for the reaction were obtained at 17 angles for proton energies between 2.1 and 3.8 MeV. A pulsed proton beam onto a thick lithium metal target provided continuous neutron time-of-flight spectra. A thick target was used because the target is highly reproducible and because counting rates are high. A disk of lithium metal was surface cut under hexane to reduce oxidation, and pressed onto the open end of a thin walled (0.25 mm thickness) target holder. The data were corrected for neutron scattering from the target. The attenuation and inscattering were evaluated experimentally. A neutron shield (lithium carbonate plus water, and paraffin) surrounded the target. The neutron detector viewed the target through a polyethylene collimator in the shield. The neutron detector was a plastic scintillator and a photomultiplier tube with a high gain first dynode. This allowed detection of events with pulse heights of two photoelectrons or greater. This low a neutron detector bias, about 50 keV recoil proton energy, is necessary to measure the angular distributions for this reaction near threshold, because of the large kinematic variation of neutron energy with emission angle. The neutron detector efficiency was determined through a simultaneous normalization of the measured angular distributions to the known total cross section at all proton energies. This technique involved writing the relation between the total cross section and the angular distribution in matrix notation with proton energy and neutron emission angle as variables, and expressing the correction to the neutron detector efficiency as a power series in neutron energy. A least squares solution of the resultant matrix equation yielded the power series coefficients, and thus determined the neutron detector efficiency. A relaxation method was also employed to determine the detector efficiency, the result was seen to converge to that of the simultaneous normalization—least squares solution technique. The simultaneous normalization technique, combined with a measurement of the thick target excitation curves at many angles, provides a good way to determine the reaction angular distributions if there is a well known total cross section available. Both the data from this experiment and an auxiliary experiment show that detection of carbon recoils in the scintillator contributed 30% of the total detector efficiency for neutron energies near 2 MeV. The efficiency determination was judged to be uncertain to about 4%. When compounded with counting statistics and scattering correction uncertainties, the resultant differential excitation curves have uncertainties between 5% and 8%. Nanosecond timing resolution and neutron flight paths of 2 to 3 meters gave 10 keV neutron energy resolution. The zero degree differential cross section (proton energies from 1.89 to 3.80 MeV), and the excitation functions and Legendre coefficients (proton energies from 2.09 to 3.80 MeV), from our measurement are presented in 10 keV increments and compared with other measurements. Results of these measurements are in better agreement with those of Bergstrom et al., than with those of Austin. An attempt was made to reproduce the Legendre coefficients by a one-level R-matrix theory calculation. (Diss. Abstr. Int., B)

21063 ACCURACY OF THE PHOTON-DIFFERENCE METHOD IN THE GIANT DIPOLE RESONACE REGION. Yamaguchi, C.; Shintomi, T.; Masuda, M. (Tokyo Inst. of Tech.). Nucl. Instrum. Methods; 106: No. 3, 471-476(1973).

A new simple and straightforward method for the analysis of the experimental photonuclear yield data in the giant dipole resonance region was developed. This is called the "yield data smoothing" method. The process to obtain the smooth curve to fit the given experimental yield data is carried out by the best-fit polynomial approximation under the convergence condition which is determined by the statistical accuracy of the data. The smooth cross section curve is induced by the yield data smoothing method. The usefulness of the present method was tested using trial yield data generated from test cross section functions. The accuracy of the photon-difference method was investigated through the solutions for the various yield functions. (auth)

21064 CROSS SECTION OF THE (γ,p) REACTION WITH THE ^{18}O NUCLEUS. Dorosh, M. M.; Mazyukevich, N. P.; Shkoda-Ul'yanov, V. A. (Uzhgorod State Univ., USSR). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 5, 847-9(May 1972). (In Russian).

The cross section of the reaction $^{18}O(\gamma,p)^{17}N$ was investigated as a possible basis for a novel analytical method for geology, metallurgy, and the chemical industry. The delayed neutron yield from O was measured by a betatron using two independent methods (thin and thick targets) within the limits from threshold (16.4 MeV) to 24.5 MeV. Averaged values for the maximum observed cross section (12 mb at 23.0 MeV), which is considerably smaller than the cross section published by other workers, are given. (KSW)

21065 EVIDENCE FOR PROXIMITY SCATTERING IN THE $^{12}C(d,n)^{13}N_{g.s.}(p)^{12}C$ REACTION. Sharma, T. C.; Cameron, J. M.; Neilson, G. C. (Univ. of Alberta, Edmonton). Nucl. Phys.; A202: No. 1, 59-70(1973).

The reaction $^{12}C(d, np)^{12}C$ was investigated to look for evidence of proximity scattering at incident energies between 5.1 and 6.25

MeV. The data follow the expected energy dependence for rescattering effects. The effects of ^{13}C contamination in the target and other sequential decays were assessed. The contribution from the singlet and triplet states of the n–p system to the rescattering enhancements was estimated and found to be negligible. The present data strongly support the existence of proximity scattering in this reaction, and serve to reject the alternative explanations of the energy spectra. (8 figures) (auth)

21066 RESCATTERING AND NEUTRON–PROTON FINAL-STATE INTERACTION IN THE $^{12}C(d,pn)^{12}C$ REACTION. Sandler, J.; Mutchler, G. S.; Von Witsch. W.; (and others) (Rice Univ., Houston, TX). Nucl. Phys.; A202: No. 1, 49-58(1973).

The $^{12}C(d, pn)^{12}C$ reaction was studied in a kinematically complete experiment at several energies and angles suitable for observing photon–neutron rescattering and sequential decay final-state interactions, with the aim of investigating the relative importance of the two reaction mechanisms. An increase of yield was observed for all spectra in the region of low relative proton–neutron energy, where both rescattering and sequential decay leading to the $^1S_0$ final-state interaction are possible. No consistent fits to the data using only the rescattering graph were found, and interference with other diagrams must be assumed to occur. The effect of isospin nonconservation is discussed. It is concluded that no reported measurements on this reaction require an exclusive interpretation in terms of a rescattering mechanism and, therefore, no reliable information on nuclear lifetimes can be obtained from these experiments. (8 figures) (auth)

21067 STATISTICAL FLUCTUATIONS AND COMPOUND ELASTIC SCATTERING FOR $^{12}C(^{12}C,^{12}C)^{12}C$ AND $^{16}O(^{16}O,^{16}O)^{16}O$. Bondorf, J. P. (Niels Bohr Inst., Copenhagen). Nucl. Phys.; A202: No. 1, 30-36(1973).

The difference between the observed fluctuations in the elastic excitation functions for carbon–carbon and oxygen–oxygen scattering, just above the Coulomb barrier, is interpreted in terms of the compound-nucleus model. (4 figures, 2 tables) (auth)

21068 ENERGY LEVELS OF ^{14}C. Ajzenberg–Selove, F. (Univ. of Pennsylvania, Philadelphia) Bingham, H. G.; Garrett, J. D. Nucl. Phys.; A202: No. 1, 150-160(1973).

The $^9Be(^6Li,p)^{14}C$ reaction was studied using 20-MeV ^6Li ions and the Penn multiangle spectrograph. Proton groups corresponding to thirty excited states of ^{14}C with $E_x < 18.2$ MeV are reported. The total cross section for formation of the six bound excited states, whose J^π are known, is proportional to $2J_f + 1$ rule and a comparison of the experimental widths and widths predicted from neutron penetration of a centrifugal barrier. (3 figures, 2 tables) (auth)

21069 ELASTIC SCATTERING OF NEGATIVE PIONS FROM ^{16}O IN THE REGION OF THE (3,3) RESONANCE. Kerns, R. L. Charlottesville, VA; Univ. of Virginia (1972). 99p. University Microfilms Order No. 72-23,481.

Thesis.

The elastic differential cross sections for $\pi^- - ^{16}O$ were measured at incident pion kinetic energies of 160, 170, 220, 230, and 240 MeV using a double magnetic spectrometer to separate elastic from inelastic scattering. An energy-loss resolution of 3 to 4 MeV allowed the separation of elastic scattering since the first excited state of ^{16}O is 6.05 MeV. The cross sections varied from the order of a few hundred mb/sr at angles <20° to the order of a few hundredths of a mb/sr at angles >70°. First minima were observed at ≈48° at the lower energies and ≈40° at the higher energies. Theoretical calculations using the Kisslinger optical model approach have been made, and the interaction is seen to be primarily absorptive near the (3,3) resonance. (Diss. Abstr. Int., B)

21070 PION PRODUCTION BY 600 MeV PROTONS ON LIGHT NUCLEI. Eisenberg, J. M.; Guy, R.; Noble, J. V.; Weber, H. J. (Univ. of Virginia, Charlottesville). Phys. Lett.; 43B: No. 1, 20-22(8 Jan 1973).

The forward cross section at $E_p = 600$ MeV is calculated for the reaction $p + (N,Z) \rightarrow (N + 1,Z)^* + \pi^+$ by using a single-nucleon mechanism, distorted pion and proton wave functions, and bound-state nucleon wave functions with realistic asymptotic behavior. Good agreement with experiment is found for ^4He, ^{12}C, and ^{14}N. (auth)

21071 ANALYSIS OF (π^+,p) AND (p,π^+) REACTIONS. Rost, E.; Kunz, P. D. (Univ. of Colorado, Boulder). Phys. Lett.; 43B: No. 1, 17-19(8 Jan 1973).

The reactions $^{12}C(\pi^+,p)^{11}C$ and $^{12}C(p,\pi^+)^{13}C$ are analyzed by assuming single neutron pickup or stripping in a distorted-wave Born-approximation framework. Qualitative agreement with experiment is obtained. (auth)

21072 LOW-ENERGY NEUTRINO REACTIONS WITH ^{12}C AND ^{16}O. Donnelly, T. W. (Stanford Univ., CA). Phys. Lett.; 43B: No. 2, 93-97(22 Jan 1973).

Inelastic electron scattering is used to help eliminate nuclear physics uncertainties in predicting cross sections, both differential and integrated, for electron neutrino reactions with ^{12}C and ^{16}O appropriate for 0 to 53-MeV neutrinos from stopped muon decay. (auth)

21073 SPECIAL NON-CENTRAL FORCES FOR sd-SHELL NUCLEI. Conze, M.; Feldmeier, H.; Manakos, P. (Technische Hochschule, Darmstadt, Ger.). Phys. Lett.; 43B: No. 2, 101-104 (22 Jan 1972).

A special noncentral component ALS of the residual interaction influences significantly the spectra of sd-shell nuclei. Calculations performed for A = 18, 19, 20, and 24 show that the spectra calculated with $(sd)^n$ configurations can be substantially improved by choosing a suitable strength for this part of the interaction. (auth)

21074 ESTABLISHMENT OF THE EXISTENCE OF VERY HIGH ENERGY STATES OF THE ^{12}C NUCLEUS RESULTING FROM RADIATIVE CAPTURE: $^9Be(^3He,\gamma)^{12}C$. Linck, I.; Kraus, Ludolf (CNRS, Strasbourg). Compt. Rend., Ser. B; 275: No. 18, 669-672(30 Oct 1972). (In French).

The ^3He radiative capture excitation curves of ^9Be nuclei were determined for incident energies between 1.5 and 11 MeV. The existence of several resonances having widths of the order of 2 MeV was established, these resonances corresponding to ^{12}C excitation energies ranging from 27 to 35 MeV. (FR)

21075 OFF-SHELL EFFECTS IN ^{18}O AND ^{18}F SHELL-MODEL SPECTRA. Pradhan, H. C.; Sauer, P. U.; Vary, J. P. (Massachusetts Inst. of Tech., Cambridge). pp 126-131 of Two-body force in nuclei. Austin, S. M. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on the Two-Body Force in Nuclei; Ann Arbor, Michigan, United States of America (USA) (7 Sep 1971). See CONF-710915–.

The effective interaction is approximated by the sum of the bare reaction matrix, G, and the three-particle–one-hole core-polarization correction. In this limited model the degree of sensitivity that the low-lying shell-model spectrum exhibits to changes in the off-shell behavior of the free two-nucleon interaction is examined. Spectra obtained from potentials exactly phase-equivalent with the Reid soft-core potential are compared. Relative cm matrix elements of $G(\omega)$ are tabulated, and calculated T = 1 spectra of ^{18}O and T = 0 spectra of ^{18}F are shown. It is concluded that there is strong sensitivity of the low-lying ^{18}F and ^{18}O spectra with respect to the off-shell behavior of the nucleon–nucleon interaction in the relative S waves. (3 figures, 2 tables) (RWR)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 19929, 21060, 21063, 21073, 21089, 21090, 21119, 21165, and 21237.

21076 (LYCEN–7255) STUDY OF EVEN–ODD NUCLEI WITH N OR Z = 11. Lambert, M.; Midy, P.; Desgrolard, P. (Lyon Univ. (France). Institut de Physique Nucleaire). Sep 1972. 34p. Dep. NTIS (U. S. Sales Only).

The five even–odd nuclei ^{19}O, ^{21}Ne, ^{21}Na, ^{23}Na, and ^{23}Mg were studied in the framework of the Bohr–Mottelson and Nilsson models. Two different methods of calculation were used for the energies and wave functions of positive- and negative-parity states. The ground-state static moments and M1–E2 transition rates were computed. It was confirmed that these nuclei (except ^{19}O) show an equilibrium prolate deformation and are well described by the model, especially with respect to the positive-parity particle states. Difficulties arise for most of the hole states and negative-parity particle states. (FR)

21077 (LYCEN–7256) STUDY OF EVEN–ODD NUCLEI WITH N OR Z = 13. Lambert, M.; Midy, P.; Desgrolard, P. (Lyon Univ. (France). Institut de Physique Nucleaire). Sep 1972. 30p. Dep. NTIS (U. S. Sales Only).

The five even–odd nuclei ^{23}Ne, ^{25}Mg, ^{25}Al, ^{27}Al, and ^{27}Si were studied in the framework of the Bohr–Mottelson and Nilsson models. General conclusions on the validity of the model in the lower part of the 2s–1d shell were drawn. (FR)

21078 ENERGY AND ANGULAR DISTRIBUTIONS OF α PARTICLES FROM THE REACTION $^{20}Ne(n,\alpha)^{17}O$ FOR NEUTRON ENERGIES OF 14.1 ± 0.1 MeV. Bachinger, R.; Uhl, M. Acta Phys. Austr.; 33: No. 3-4, 317-27(1971). (In German).

The reaction $^{20}Ne(n,\alpha)^{17}O$ was studied at a neutron energy of 14.1 ± 0.1 MeV by means of nuclear track plates. Both total and differential cross sections were determined for the ^{17}O levels with 0.0, 0.871, and 3.058 MeV excitation energies. In the higher excited states of the residual nucleus, the alpha groups could not be separated; therefore, the angular distribution was ascertained for all alpha particles that lead to excitation energies between 3 and 5 MeV. (8 figures, 2 tables) (tr-auth)

21079 STUDY OF NUCLEAR LEVELS IN ^{32}S BY THE REACTION $^{28}Si(\alpha,\alpha)^{28}Si$ AND SINGLE PARTICLE POTENTIAL REPRESENTATION. Leung, M. K. (Lexington, KY; Univ. of Kentucky (1972). 133p. University Microfilms Order No. 72-29,280.

Thesis.

The differential cross section for alpha particles elastically scattered from ^{28}Si was measured at four angles. Twenty-five resonances were observed in the excitation function in the energy range from 2.5 to 5.9 MeV. Twenty-two of these resonances were analyzed yielding resonance energies, spin and parity assignments, total resonance widths and partial α-widths. Spin and parity assignments, and resonance energy were assigned to the other three resonances, but no definite resonance widths or α-widths were obtained. The analysis was done by using two computer codes, the first of which is based on a single-level approximation of the collision matrix. The second code dealt with interference between two levels having the same spin and parity when the interacting nucleon and nucleus have zero spin. Fourteen of these resonances were also observed in the $^{31}P(p,\alpha)^{28}Si$ reaction. Comparisons were made between the parameters extracted from the two experiments and the results were found to agree well with each other. Of the 25 resonances, seven are p-waves, four are d-waves, nine are f-waves, three are g-waves, and there is only one s and one h-wave. The reduced widths for all these levels were calculated. The sum of the reduced widths for each of the partial wave was compared to the sum-rule limit. It was found that the p,f,g, and h waves contributed more than fifty percent of this limit. A real Woods–Saxon type potential was sought such that the energy of the single particle anomaly coincided with the experimental centroid of the levels in each of partial waves p,f,g and h. In the course of the experiment a scattering chamber was built that can be used for both solid target scattering experiments and gas target experiments. The procedures for operating the chamber in both types of experiments are discussed. (Diss. Abstr. Int., B)

21080 DOPPLER SHIFT ATTENUATION METHOD FOR MEASURING LIFETIMES IN THE RANGE 10^{-13} TO 10^{-15} S USING HEAVY-ION INDUCED REACTIONS. Branford, D.; Wright, I. F. (Univ. of Manchester, Eng.). Nucl. Instrum. Methods; 106: No. 3, 437-443(1973).

An experimental technique for measuring lifetimes by the Doppler-shift attenuation method using heavy-ion induced reactions is described. The advantages of using heavy-ion induced reactions and the type of reaction that can be used are discussed. The detector geometry used is shown to be superior to others. A simple yet accurate method of analyzing data obtained by this method is described. The method has been used to measure lifetimes using the $^{12}C(^{16}O,\alpha)^{24}Mg$ and $^{12}C(^{16}O,d)^{26}Al$ reactions and a sample of the results obtained is presented. (auth)

21081 INELASTIC SCATTERING OF 14.4 MeV NEUTRONS FROM SEVERAL ELEMENTS. McKinney, H. O. Morgantown, WV; West Virginia Univ. (1972). 122p. University Microfilms Order No. 72-26,881.

Thesis.

Fast neutrons of 14.4 MeV were used to produce prompt gamma rays in natural Al, Bi, Cr, Cu, Fe, Mg, Pb, Ti, and Zn. Cross-sections for production of many of these gammas were measured by observing them at 90° to the incident neutron beam with a well shielded 3″ × 3″ NaI(TL) detector. When necessary, corrections were made for competing (n,p) reactions. In the cases where the first or second excited nuclear state decays by electric quadrupole radiation, excitation cross-sections are calculated and compared with the reduced transition probability, B(E2), of the state. A significant correlation is found to exist between the inelastic excitation cross-section and the B(E2) value. This correlation is well described by the equation $\sigma(\text{inelastic}) = (\text{const})B(E2)^{.546 \pm .135}$. Theoretical excitation cross-sections based on the so called "Catchler Formalism" are derived assuming an incident neutron energy of 2.5 MeV. Again a positive correlation which is well described by the relation $\sigma(\text{inelastic}) = (\text{const})B(E2)^{.451 \pm .074}$ is found. (LTW)

21082 CROSS SECTION MEASUREMENTS WITH FAST NEUTRONS. Wollesen, M. Atomkernenergie; 20: No. 3, 245-247(Dec 1972). (In German).

A neutron time-of-flight spectrometer is described, by which the differential cross sections for elastic and inelastic scattering of MeV neutrons can be measured. Experimental setup and measuring method are described. A brief report is given of the results for Al and Cr, which have been examined more thoroughly in the energy range E_n = 3.45 to 4.3 MeV. (auth)

21083 NEUTRON-INDUCED GAMMA-RAY REACTIONS IN ^{23}Na IN THE ENERGY RANGE $4.85 \leq E_n \leq 7.5$ MeV. Dickens, J. K. (Oak Ridge National Lab., TN). Nucl. Sci. Eng.; 50: No. 2, 98-107 (Feb 1973).

Interactions of neutrons with sodium were studied by measuring gamma-ray-production cross sections. Spectra were obtained for incident mean neutron energies E_n = 4.85, 5.4, 5.9, 6.45, 7.0, and 7.5 MeV. Data were obtained at angles of 125 and 55 deg using Ge(Li) detectors. Time-of-flight was used to discriminate against pulses due to neutrons and background radiation. Absolute cross sections for production of gamma rays were obtained for the incident neutron energies quoted above. The data were compared with previous inelastic neutron scattering results and evaluated cross sections, with good agreement. The spectra were studied for gamma rays which could be associated with deexcitation of nuclear levels having unknown decay modes. Gamma rays were found having energies appropriate for decay of levels at excitation energies E_x = 5762, 5934, 5967, 6115, 6576, and 6866 keV. (auth)

21084 LOWEST $T = 3/2$ STATE IN ^{41}Sc. Gough, R. A.; Sextro, R. G.; Cerny, J. (Univ. of California, Berkeley). Phys. Lett.; 43B: No. 1, 33-36(8 Jan 1973).

Precise energies of β^+-delayed protons emitted from the lowest $T = 3/2$ analog states in several $T_z = -1/2$ nuclei were measured. The lowest $T = 3/2$ level in ^{41}Sc was found to lie at E_x = 5935 ± 8 keV, in substantial disagreement with the previously accepted value. (auth)

21085 COUPLED-CHANNELS ANALYSIS OF 30 MeV PROTON SCATTERING FROM LOW-LYING POSITIVE-PARITY STATES IN ^{19}F, ^{20}Ne, ^{21}Ne. De Swiniarksi, R. (Institut des Sciences Nucleaires, Grenoble, France); Genoux-Lubain, A.; Bagieu, G.; Cavaignac, J. F.; Worledge, D. H.; Raynal, J. Phys. Lett.; 43B: No. 1, 27-29(8 Jan 1973).

Angular distributions were measured for the scattering of 30-MeV protons from the strongly excited low-lying positive-parity states in ^{19}F, ^{20}Ne, and ^{21}Ne. Coupled-channels calculations yield evidence for a large β_4 deformation in ^{20}Ne (+0.28 ± 0.05) and in ^{19}F (+0.14 ± 0.04). The analysis of the ^{21}Ne data indicates a possible small hexadecapole deformation below +0.05. (auth)

21086 SUPERALLOWED FERMI DECAY OF ^{34}Cl AND THE VECTOR WEAK INTERACTION. Ryder, J. S. (Oxford Univ.); Clark, G. J.; Draper, J. E.; Freeman, J. M.; Burchem, W. E.; Squier, G. T. A. Phys. Lett.; 43B: No. 1, 30-32(8 Jan 1973).

The half-life for the superallowed Fermi decay of ^{34}Cl was measured to be 1.526 ± 0.002 s; and the beta end-point energy, 4467.4 ± 1.9 keV. The deduced ft value is in good agreement with that for ^{26m}Al. The result provides no evidence for mirror asymmetry in mass-34 Fermi decays. (auth)

21087 MASS OF ^{29}S. Benenson, W. (Michigan State Univ., East Lansing); Kashy, E.; Proctor, I. D.; Preedom, B. M. Phys. Lett., B; 43B: No. 2, 117-118(22 Jan 1973).

The mass of ^{29}S was measured with the $^{32}S(\tau,^6He)$ reaction at 70 MeV. The mass excess is −3.16 ± 0.05 MeV. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 21007, 21060, 21063, 21081, 21082, 21084, 21105, 21107, 21112, 21119, 21165, 21169, 21176, 21177, 21188, 21221, 21225, 21226, 21237, 21240, and 21241.

21088 (CEA-N-1543) NEUTRON ELASTIC SCATTERING FROM ^{40}Ca BETWEEN 1.2 MeV AND 2.83 MeV. Abramson, D.; Arnaud, A.; Bluet, J. C.; Filippi, G.; Lavelaine, C.; le Rigoleur, C. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). May 1972. 38p. (In French). Dep. NTIS (U. S. Sales Only).

The angular distributions of neutrons scattered from ^{40}Ca were measured at 13 incident energies from 1.2 MeV to 2.83 MeV. Theoretical calculations were made using the optical model and Hauser–Feshbach theory with corrections for level width fluctuations. Theoretical values were obtained for (n,α) and (n,p) reactions. They are compared with the experimental results and with data from the UKEA tape. (FR)

21089 (COO-535-674) TECHNICAL PROGRESS REPORT, NOVEMBER 1, 1971–NOVEMBER 1, 1972. (Colorado Univ.,

Boulder. Dept. of Physics and Astrophysics). 1 Nov 1972. Contract AT(11-1)-535. 137p. Dep. NTIS.

ALUMINUM-27—proton reactions (p,He-3) and (p,t) at 27 MeV, DWBA analysis of differential cross sections and spectra from, (E)

ARGON-40—helium-3 reactions (He-3,t) at 35 MeV, angular distribution and spectrum from, (E)

—proton reactions (p,n) at 23 MeV, importance of two-step processes in coupled-channels calculations of angular distributions from, (T)

CALCIUM-40—proton reactions (p,d) at 27.5 MeV, finite-range nonlocal DWBA analysis of differential cross sections using real and complex form factors, (T)

—helium-3 elastic scattering at 21.0 MeV, optical-model analysis of angular distribution from, (T)

CHLORINE-32—beta decay of, beta intensities, gamma spectra, and log-ft values for, (E)

CHROMIUM-48—energy levels from chromium-50 (p,t) reactions, spin–parity assignments for, (E)

CHROMIUM-50—proton reactions (p,t) at 27 MeV, optical-model-parameter sensitivities from DWBA analysis of differential cross sections for, (T)

—proton reactions (p,t) at 27 MeV, DWBA and Hauser–Feshbach analyses of differential cross sections for, (E/T)

—proton reactions (p,t) at 27 MeV, energy spectrum from, (E)

—alpha inelastic scattering at 35 MeV, DWBA analysis of differential cross sections for, (E)

—energy levels from alpha inelastic scattering, spin–parity assignments for, (E)

CYCLOTRONS—development and operation of Colorado Univ., Boulder, Nov. 1, 1971–Nov. 1, 1972

—experimental facilities at Colorado Univ., Boulder, description of magnetic spectrograph

GERMANIUM-68—energy levels from germanium-70 (p,t) reactions, spin–parity assignments for, (E)

GERMANIUM-70—proton reactions (p,t) at 27 MeV, optical-model-parameter sensitivities from DWBA analysis of differential cross sections for, (T)

—proton reactions (p,t) at 27 MeV, single-step DWBA and two-step coupled-channels calculations of differential cross sections for, (T)

—proton reactions (p,t) at 27 MeV, energy spectrum from, (E)

—proton reactions (p,t) at 20 MeV, DWBA analysis of differential cross sections using real and complex form factors, (T)

HELIUM-3—reactions (He-3,t) with A = 50 to 90 nuclei at 21.4 to 70.0 MeV, DWBA and analysis of differential cross sections using real and complex effective interactions, (T)

IRON-54—helium-3 reactions (He-3,t) at 21.4 to 37.5 MeV, energy dependence in DWBA analysis of differential cross sections for, (T)

—proton reactions (p,n) at 22.8 MeV, importance of two-step processes in differential cross sections for, (T)

MAGNESIUM-24—alpha reactions (α,He-3) and (α,t) at 36 MeV, simultaneous energy spectra from, (E)

MAGNESIUM-26—proton reactions (p,n) at 23 MeV, importance of two-step processes in coupled-channels calculations of angular distributions from, (T)

—proton reactions (p,t) at 27 MeV, DWBA and Hauser–Feshbach analysis of differential cross sections for, (E/T)

NICKEL-57—energy levels from nickel-58 (He-3,α) and (p,t) reactions, isospin assignments and spectroscopic factors for, (E)

NICKEL-58—helium-3 reactions (He-3,α) with, DWBA analysis of differential cross sections for, (E)

—proton reactions (p,d) at 27.5 MeV, finite-range nonlocal DWBA analysis of differential cross sections using real and complex form factors, (T)

—proton reactions (p,t) at 27 MeV, DWBA analysis of differential cross sections using real and complex form factors, (T)

NIOBIUM-93—helium-3 reactions (He-3,Be-7) at 41.3 MeV, analysis of differential cross sections and spectrum from, (E)

NUCLEAR MODELS—optical, determination of neutron potentials using proton elastic scattering and (p,n) reactions, (T)

NUCLEAR REACTIONS—form factors for transfer, procedure for generating complex, (T)

—wave functions for two-nucleon-transfer, one-dimensional solution for, (T)

NUCLEI—proton reactions (p,n) with A = 9 to 208, at 22.8 MeV, analysis of differential cross sections using DWBA with complex isospin-dependent optical potential and microscopic model with Yukawa interaction, (T)

NUCLEI, INTERMEDIATE—neutron elastic scattering by Z = 26 to 50, optical potential from proton elastic scattering and (p,n) reactions, (T)

OXYGEN-16—proton reactions (p,He-3) and (p,t) at 27 MeV, violation of isospin intensity rules in ratio of differential cross sections for, (E)

SCANDIUM-40—beta decay of, beta intensities, gamma spectra, and log-ft values for, (E)

TIN ISOTOPES—proton reactions (p,t) with even, A dependence of cross sections in pairing model, (T)

—triton reactions (t,p) with even, A dependence of cross sections in pairing model, (T)

TITANIUM-46—proton reactions (p,t) at 27 MeV, optical-model-parameter sensitivities from DWBA analysis of differential cross sections for, (T)

TITANIUM-48—proton reactions (p,t) at 27 MeV, optical-model-parameter sensitivities from DWBA analysis of differential cross sections for, (T)

TITANIUM-50—proton reactions (p,t) at 19 to 27 MeV, optical-model-parameter sensitivities from DWBA analysis of differential cross sections for, (T)

—proton reactions (p,t) at 23 and 27 MeV, coupled-channels calculation of two-step processes in differential cross sections for, (T)

X-RAY FLUORESCENCE ANALYSIS—developments at Colorado Univ., Boulder, Nov. 1, 1971–Nov. 1, 1972

ZIRCONIUM-90—proton reactions (p,t) at 27 MeV, DWBA analysis of differential cross sections using real and complex form factors, (T)

—proton reactions (p,n) at 23 MeV, importance of two-step processes in coupled-channels calculations of angular distributions from, (T)

ZIRCONIUM-92—helium-3 reactions (He-3,Be-7) at 41.3 MeV, analysis of differential cross sections and spectrum from, (E)

ZIRCONIUM-96—proton reactions (p,n) at 23 MeV, importance of two-step processes in coupled-channels calculations of angular distributions from, (T)

21090 (EURFNR-1037) MEASUREMENT AND FLUCTUATION ANALYSIS OF γ-RAY PRODUCTION CROSS SECTIONS AFTER INELASTIC NEUTRON SCATTERING ON ^{56}Fe AND ^{27}Al BETWEEN 0.8 AND 13 MeV. Voss, F. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Apr 1972. 76p. (KFK-1611). Dep. NTIS.

Thesis. Submitted to Karlsruhe Univ., West Germany. Work performed under United States–Euratom Fast Reactor Exchange Program.

A new two-parameter experiment for the measurement of high-resolution γ-ray production cross sections from inelastic neutron scattering is described. The excitation functions of four γ transitions in ^{56}Fe and five γ transitions in ^{27}Al were measured in the energy range from 0.8 to 13 MeV. A fluctuation analysis was carried out using an autocorrelation function, and average level widths of the compound nuclei ^{57}Fe and ^{28}Al were determined. In the case of aluminum a significant dependence of the correlation widths on the exit channel was found. The excitation functions were investigated for intermediate structure. Some of the prominent structure appeared correlated in different inelastic channels, this correlation suggesting the possible existence of doorway states. (22 figures, 6 tables, 73 references) (auth)

21091 (FEI-260) STATISTICAL PROPERTIES OF LOW EXCITATION ENERGY ATOMIC NUCLEI SPECTRA. Sokolov, Yu.; Stavinskii, V. S. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1971. 24p. (In Russian). INIS.

A theoretical analysis was conducted of the energy dependence of the density of levels of the nuclei ^{41}Ca, ^{50,51,52,54,55}Cr, ^{55,56}Fe, and ^{56}Mn as obtained from (p,p') and (d,p) reactions. A refined Fermi-gas model was used, with a phenomenological allowance made for residual interactions. Possible sources of deviation on the part of predictions by this simple model from experimental data are considered. (tr-auth)

21092 (FRNC-TH-310) STUDY OF (d, ^{6}Li) REACTIONS WITH ^{40,42}Ca, ^{56}Fe, AND ^{58}Ni NUCLEI. Le Chalony, Y. (Universite Scientifique et Medicale de Grenoble (France)). 1972. 52p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

Twenty-eight-MeV deuterons were used to study (d, ^{6}Li) reactions with ^{40}Ca, ^{42}Ca, ^{56}Fe and ^{58}Ni nuclei. Levels having excitation energies up to about 5 MeV could be obtained. Only the first and second 0^+ and 2^+ levels of the ^{36}Ar, ^{38}Ar, ^{52}Cr and ^{54}Fe nuclei were considered. Theoretical studies demonstrate that (d, ^{6}Li) reactions proceed by a direct reaction mechanism. The angular distri-

butions are sufficiently well reproduced using DWBA calculations even when using the zero-range approximation. The results of the analysis are very dependent on the optical parameters of ^{6}Li. A coherent analysis of the results enabled comparison to be made between the experimental spectroscopic factors obtained in the different reactions; a sharp decrease in the value of the spectroscopic factor when one passes from ^{40}Ca to nuclei of the (f,p) shell was observed. (FR)

21093 EXCITATION CURVES AND THICK-TARGET YIELD CURVES OF ^{52}Fe, ^{55}Fe, ^{56}Mn, ^{48}Cr, ^{49}Cr, ^{51}Cr, AND ^{48}V FOR THE (Cr + ^{3}He) REACTIONS ON NATURAL CHROMIUM. Akiha, F. (Hirosaki Univ., Aomori, Japan); Murakami, Y. Nippon Kagaku Kaishi; 1972: No. 8, 1416-1421(Aug 1972). (In Japanese).

^{3}He bombardment of a natural chromium target with the aim of production of ^{52}Fe in practical amounts for medical use is discussed. The excitation curves and thick-target yield curves were measured for the formation of ^{52}Fe and other by-product radioisotopes, such as ^{55}Fe, ^{56}Mn, ^{48}Cr, ^{49}Cr, ^{51}Cr and ^{48}V, formed during bombardment with ^{3}He particles up to 44 MeV. Also, various conditions in the production procedure, especially the yield of ^{52}Fe and other by-product radioisotopes, were examined. The method used was as follows: The stacked metallic chromium plates (each of 30 mm dia, 20 to 40 mg/cm^{2}) were made into a sufficiently thick target for the bombardment in the cyclotron in the ranges of the incident particle energy, followed by chemical or nondestructive separation of the iron radioactivities, and the activities of relatively long-lived products formed in each target were measured with calibrated scintillation counter and proportional counter. The excitation curve of ^{52}Fe shows a maximum of 5 mb near 35 MeV energy. The average thick-target yield of ^{52}Fe for 40 MeV incident energy is 50 μCi/μA-hr and the ^{55}Fe/^{52}Fe ratio is 0.07%. It is advantageous for medical use that this ratio is very small in comparison with that for α-particle bombardment on a natural chromium target. Thus, the production of ^{52}Fe via the ^{3}He reaction on natural chromium proved to be superior to other possible reactions in its high yields as well as in other points. (auth)

21094 ELASTIC SCATTERING OF ALPHA PARTICLES TOGETHER WITH A MICROSCOPIC INTERPRETATION. Mailandt, P. Minneapolis; Univ. of Minnesota (1972). 159p. University Microfilms Order No. 72-27,778.

Thesis.

Experiments are reported on the elastic scattering of alpha particles by ^{45}Sc, ^{65}Cu, ^{90}Zr, and ^{122}Sn and the interpretation of the data in terms of current theories based upon potential models of the atomic nucleus. A detailed description is given of a new scattering chamber, and its associated equipment which have been used for the measurements of the differential cross sections using 27 MeV alpha particles scattered by the targets in the angular range from 18 to 175 degrees. These experimental results are first analyzed using the standard six-parameter optical model which is based upon a phenomenological parametrization of the alpha-nucleus interaction potential. Difficulties and shortcomings of this model are discussed. A more sophisticated optical model is then used to reanalyze the experimental data. In this new model the real parts of the potential are obtained from nuclear-matter distributions and information about the alpha-nucleon interaction. This microscopic model is shown to fit the data as well or better than the standard optical model even though two fewer parameters are used. The nuclear-matter distributions were initially taken to be equal to the nuclear proton distributions, which were derived from results obtained (by others) in the interpretation of electron- and x-ray scattering. These parameters were considered fixed in the 4-parameter microscopic model. The effective alpha-nucleon interaction potential has been found by simultaneously fitting a large set of α-nucleon data which cover adequately the energy range of interest. Investigations were also done using a 6-parameter microscopic model in which the matter parameters were allowed to adjust themselves for optimum fit to the data. The results of these searches were interpreted to yield information about the distribution of neutrons in the surface of the nucleus relative to the distribution of nuclear protons. It is found that the results are consistent with results of other work. For the three lighter elements little difference in the radial extent of the neutron- and proton distribution is found. For tin, the numerical value for the neutron radius excess is in good agreement with results obtained in analyses of proton elastic scattering. In the discussions of the microscopic optical model it has been attempted to emphasize the numerous advantages this description has over the standard optical model. (Diss. Abstr. Int., B)

21095 ENERGY LEVEL STRUCTURE OF ^{50}Mn. McKenna, C. M. Tallahassee; Florida State Univ. (1972). 179p. University Microfilms Order No. 72-21,322.

Thesis.

The ^{50}Cr(p,n)^{50}Mn and ^{50}Cr(^{3}He,t)^{50}Mn reactions were employed to populate low-lying energy levels in ^{50}Mn. Properties of these levels were investigated by means of beta-, gamma-, neutron-, and charged-particle spectroscopy. The threshold energies for the reactions ^{50}Cr(p,n)^{50}Mn^{g} and ^{50}Cr(p,n)^{50}Mn^{m} were determined by observing residual activity following the bombardment of an isotopically enriched ^{50}Cr target. The threshold for the onset of the superallowed (0.290 sec) activity was measured to be $8.560^{+.022}_{-.008}$ MeV, while the threshold for the onset of the allowed (105.6 sec) activity was observed at $8.812^{+.025}_{-.020}$ MeV. The ground state Q-value and mass excess were determined from these measurements. The absolute values of the total cross sections for the ^{50}Cr(p,n)^{50}Mn^{g} and ^{50}Cr(p,n)^{50}Mn^{m} reactions were measured and found to be in a ratio of 6:1 at an energy of 1.85 MeV above the ground state threshold. Observation of the positron decays of the ^{50}Mn isomeric levels to known states of ^{50}Cr permitted unambiguous spin and parity assignments of 0^{+}, T = 1 to be made for the ^{50}Mn ground state and 5^{+}, T = 0 for the .227 MeV state. Information on spins and excitation energies of additional ^{50}Mn levels was obtained by employing the ^{50}Cr(p,n)^{50}Mn reaction in conjunction with ^{3}He proportional counters and an n-γ coincidence system. With triton spectra from the ^{50}Cr(^{3}He,t)^{50}Mn reaction, a total of 30 states at excitation energies up to 4 MeV in ^{50}Mn were identified. Angular distributions of tritons for levels at less than 2 MeV excitation were analyzed in terms of a DWBA microscopic formalism. Assuming that the low-lying states in ^{50}Mn have positive parities, tentative spin and parity assignments were made for the seven states in addition to the isomeric levels, observed at less than 2 MeV excitation, based on the combined experimental information. Thus, ^{50}Mn excited states at .650-, .800-, 1.030-, 1.140-, 1.79-, 1.86-, and 1.92-MeV were assigned spins of $1^{+}(2^{+})$, $2^{+}(1^{+})$, 7^{+}, 3^{+}, 4^{+}, $1^{+}(2^{+})$ and $5^{+}(6^{+})$ respectively. (Diss. Abstr. Int., B)

21096 WEAK TRANSITIONS IN ^{44}Ca. Tauhata, L.; Marques, A. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis.; 18: No. 21, 289-97(1972).

The β decay of ^{44}Sc was followed through the lifetimes of its ground state and 6^{+} isomeric state. Singles and coincidence spectra were observed. In addition to the well known transitions in ^{44}Ca, γ rays at 564 and 728 keV were detected. Weak transitions at 2246, 880, and 1669 keV were also seen but not included in the level scheme. (LTW)

21097 ENERGIES OF THE 122 AND 136 keV LINES OF ^{57}Fe. Heim, Ursula; Schult, O. W. B. (Technical Univ., Munich). Z. Naturforsch.; 27a: No. 12, 1p(Dec 1972).

The energies of the 122- and 136-keV γ lines of ^{57}Fe were measured to be 122.0638 and 136.4785 keV with relative energy errors of 1.5 eV and absolute energy errors of 3.0 and 3.5 eV, respectively. (LTW)

21098 ASPECTS OF α-emission from the bombardment of ^{58}Ni WITH 14.7 MeV NEUTRONS. Khan, N. A.; Mubarakmand, S.; Ahmad, M. (Atomic Energy Centre, Lahore). Nucl. Phys.; A202: No. 1, 123-126(1973).

An enriched ^{58}Ni target was bombarded with 14.7-MeV neutrons, and the energies and angular distributions of the outgoing α particles were measured. A statistical-theory analysis was made which yields a value of 1.022 ± 0.15 MeV for the nuclear temperature and a value of 9.7 ± 0.45 MeV^{-1} for the level density parameter of ^{55}Fe. The total cross section was also measured. The results compared with previous measurements. (4 figures) (auth)

21099 EFFECTS OF OPERATOR RENORMALIZATION ON INELASTIC SCATTERING CALCULATIONS IN ^{40}Ca. McManus, H.; Dworzecka, M.; Hammerstein, G. R. (Michigan State Univ., East Lansing). Phys. Lett.; 43B: No. 1, 9-12(8 Jan 1973).

Transition densities are calculated in TDA which include effects of both wave function and transition operator renormalization. These densities are used to calculate (e,e') form factors and (p,p') cross sections. Results are compared with experiment. (auth)

21100 COUPLING OF PARTICLE–HOLE STATES TO VIBRATIONS. Zamick, L. (Rutgers—The State Univ., New Brunswick, NJ). pp 235-240 of Two-Body Force in Nuclei. Austin, S. M. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on the Two-Body Force in Nuclei; Ann Arbor, Michigan, United States of America (USA) (7 Sep 1971). See CONF-710915–.

The two-particle–two-hole states of a closed-shell nucleus such as ^{40}Ca are considered in a formalism in which the one-particle–one-hole vibrational states, e.g., 3^{-}, 5^{-}, enter explicitly. The two particles are in the f–p shell (negative parity); the two holes, in the s–d shell (positive parity). Display of the configuration mixing in collective states yields better results than a simple effective interaction treatment. A surface-delta interaction is employed in three different calculations; the results of these calculations for the energies of 2p–2h J = 0 states in ^{40}Ca are given. (RWR)

21101 EXPERIMENTAL REVIEW OF THE (^{3}He,^{3}He'), (^{3}He,t), AND (α,α') REACTIONS. Roos, P. G. pp 333-353 of Two-body force in nuclei. Austin, S. M. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on the Two-Body Force in Nuclei; Ann Arbor, Michigan, United States of America (USA) (7 Sep 1971). See CONF-710915-.

A simple model for describing reactions involving complex projectiles is presented first, and then the difficulties arising from applications of the microscopic theory to experimental data are discussed. Advantages of using the (^{3}He,t) reaction are reviewed. The first problem in application arose in the analysis of (^{3}He,t) transitions to natural-parity states with no spin-flip contributions, and concerned the strength of the interactions. A second difficulty was the shape of the angular distributions for transitions to antianalog states. Both problems may be explained by the inclusion of two-step processes, such as (^{3}He,α) followed by (α,t). The third problem occurred for transitions to unnatural-parity states. It was found that angular distributions for unnatural-parity states, which have contributions from two possible L transfers, were generally dominated by the higher L transfer. The solution to this problem was found by introducing a tensor force into the ^{3}He–nucleon interaction. In summary, however, the microscopic effective interaction, even with the tensor force, will not predict the (^{3}He,t) cross sections. Two additional considerations of importance in the charge-exchange reaction are core polarization and the energy dependence of the effective interaction. A microscopic analysis of inelastic scattering is then taken up. The cross section for ^{3}He inelastic scattering is nearly correct without including exchange; when exchange is included, the theoretical cross section becomes a factor of 2 too large. α inelastic scattering, on the other hand, is nearly correct when exchange is included. Investigation of the phase in scattering by ^{208}Pb indicated a real interaction for α scattering, but an imaginary one for ^{3}He. A possible explanation is the virtual breakup of the ^{3}He, since it is very loosely bound when compared to the α particle. The effect of core polarization in inelastic scattering is examined for a case where the shell-model space is very limited; the core polarization completely dominates the cross section, and essentially no information is obtained about the effective interaction. All of the difficulties with the effective interaction are primarily associated with ^{3}He reactions; inelastic α scattering appears to be quite well described by a microscopic model (+ core polarization). (15 figures) (RWR)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 19857, 20509, 21007, 21081, 21091, 21094, 21107, 21110, 21111, 21119, 21126, 21151, and 21241.

21102 (ORNL–4846) GAMMA-RAY PRODUCTION DUE TO NEUTRON INTERACTIONS WITH COPPER FOR INCIDENT NEUTRON ENERGIES BETWEEN 1.0 AND 20 MeV: TABULATED DIFFERENTIAL CROSS SECTIONS. Dickens, J. K.; Love, T. A.; Morgan, G. L. (Oak Ridge National Lab., Tenn). Feb 1973. Contract W-7405-eng-26. 44p. Dep. NTIS $4.00.

Numerical values of differential cross sections for gamma rays produced by neutron reactions with copper were obtained for neutron energies between 1.0 and 20 MeV for $\theta_\gamma = 125$ deg. The $d^2\sigma/d\omega dE$ values were obtained using a NaI spectrometer. These data consist of neutron and gamma-ray production group cross section values of $d^2\sigma/d\omega dE$ for $0.7 \geq E_\gamma \leq 10.5$ MeV, with gamma-ray intervals ranging from 20 keV for $E_\gamma \leq 1$ MeV to 160 keV for $E_\gamma \sim 9$ MeV. Neutron energy intervals vary from 0.5 MeV for $E_n = 1$ to 5 MeV to 3 MeV for $E_n = 14$ to 20 MeV. (auth)

21103 GAMMA RAYS FROM THE NEW ISOTOPE (3.6 ± 0.2) min ^{77}Rb. De Boer, F.W.N.; Lingeman, E.W.A.; Meijer, B. J. (Instituut voor Kernphysisch Onderzoek, Amsterdam). Radiochim. Acta; 18: No. 1, 60-61(Dec 1972).

Activity ascribed to ^{77}Rb was produced by the bombardment of ^{75}Br with ^{3}He ions at 30 to 75 MeV. As subsequently published papers have shown some contradictory results, the earlier work is discussed in greater detail. The gamma spectrum from this decay is shown; the half-life of ^{77}Rb was found to be 3.6 ± 0.2 min. (1 figure, 1 table) (RWR)

21104 NEUTRON PARTICLE STRUCTURE OF THE GERMANIUM ISOTOPES. Fournier, R.; (Univ. of Ottawa); Kroon, J.; Hsu, T. H.; Hird, B.; Ball, G. C. Nucl. Phys.; A202: No. 1, 1-29 (1973).

The levels of ^{71,72,73,75}Ge were investigated with the (p,d) reaction at 20 MeV. DWBA predictions were used to obtain l_n transfers and absolute spectroscopic factors. In the reactions with the even-A targets only one $l_n = 4$ transfer was observed, and a single $l_n = 1$ transfer to a low-lying level carried most of the available $2p_{\frac{3}{2}}$ spectroscopic strength. In contrast, approximately 50% of $2p_{\frac{3}{2}}$ and $1f_{\frac{5}{2}}$ spectroscopic strengths were found to be spread over many levels at higher excitation. The center-of-gravity energies and filling coefficients of the $2p_{\frac{3}{2}}$, $1f_{\frac{5}{2}}$, $2p_{\frac{1}{2}}$, and $1g_{\frac{9}{2}}$ neutron subshells calculated from these measurements are in generally good agreement with the existing information on Ni, Zn, and Se. The $2p_{\frac{3}{2}}$ and $1f_{\frac{5}{2}}$ shells are almost full for N > 38, and additional neutrons preferentially fill the $1g_{\frac{9}{2}}$ shell. (12 figures, 8 tables) (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 19857, 20509, 20761, 21007, 21060, 21063, 21081, 21089, 21094, 21101, 21149, 21151, 21165, 21169, 21178, 21221, and 21241.

21105 (ANCR–1088, pp 47-80) NUCLEAR PROPERTIES. Oct 1972.

In Nuclear Technology Division annual progress report for period ending June 30, 1972.

ALUMINUM-27—proton reactions at 590 MeV, cross sections for spallation, (E)
BARIUM-140—beta decay of, evaluated gamma spectra and half-life for, (E)
CARBON—proton reactions at 590 MeV, cross section for spallation, (E)
CESIUM-138—beta decay of, evaluated gamma spectra and half-life for, (E)
COBALT-58—beta and electron-capture decay of, evaluated gamma spectra and half-life for, (E)
COBALT-59—neutron capture at 2 keV, gamma spectrum from, (E)
COBALT-60—beta decay of, evaluated gamma spectra and half-life for, (E)
COPPER—proton reactions at 590 MeV, cross sections for spallation, (E)
COPPER-64—electron-capture decay of, evaluated gamma spectra and half-life for, (E)
GADOLINIUM-155—neutron capture at 2 keV, gamma spectrum from, (E)
GOLD-198—beta decay of, evaluated gamma spectra and half-life for, (E)
INDIUM-115—decay of isomeric, half-life for, (E)
—isomeric transition in, evaluated spectra and half-life for, (E)
—beta decay of, evaluated gamma spectra and half-life for, (E)
INDIUM-116—isomeric transition in, evaluated spectra and half-life for, (E)
—beta decay of, evaluated gamma spectra and half-life for, (E)
IRIDIUM-192—beta and electron-capture decay of, branching ratios and gamma spectra from, (E)
IRON—proton reactions at 590 MeV, cross sections for spallation, (E)
IRON-59—beta decay of, evaluated gamma spectra and half-life for, (E)
KRYPTON-85—beta decay of isomeric, evaluated gamma spectra and half-life for, (E)
KRYPTON-87—beta decay of, evaluated gamma spectra and half-life for, (E)
KRYPTON-88—beta decay of, evaluated gamma spectra and half-life for, (E)
KRYPTON-89—beta decay of, evaluated gamma spectra and half-life for, (E)
LANTHANUM-140—beta decay of, evaluated gamma intensities from, (E)
—beta decay of, evaluated gamma spectra and half-life for, (E)
MAGNESIUM-27—beta decay of, evaluated gamma spectra and half-life for, (E)
MANGANESE-54—electron capture decay of, evaluated gamma spectra and half-life for, (E)
NEPTUNIUM-239—beta decay of, evaluated gamma spectra and half-life for, (E)
NICKEL—neutron capture at 2 keV, gamma spectrum from, (E)
NIOBIUM-95—beta decay of, evaluated gamma intensities from, (E)
NIOBIUM-97—beta decay of, evaluated gamma intensities from, (E)
OSMIUM-192—energy levels from iridium-192 decay, (E)

PLATINUM-192—energy levels from iridium-192 decay, (E)
RHENIUM-184—decay of isomeric, internal conversion spectra from, (E)
RUBIDIUM-88—beta decay of, evaluated gamma spectra and half-life for, (E)
RUBIDIUM-89—beta decay of, evaluated gamma spectra and half-life for, (E)
RUTHENIUM-103—beta decay of, evaluated gamma intensities from, (E)
SCANDIUM-46—beta decay of, evaluated gamma spectra and half-life for, (E)
SCANDIUM-47—beta decay of, evaluated gamma spectra and half-life for, (E)
SCANDIUM-48—beta decay of, evaluated gamma spectra and half-life for, (E)
SODIUM-24—beta decay of, evaluated gamma spectra and half-life for, (E)
TERBIUM-160—beta decay of, internal conversion spectra from, (E)
XENON-131—isomeric transition in, evaluated spectra and half-life for, (E)
XENON-133—isomeric transition in, evaluated spectra and half-life for, (E)
—beta decay of, evaluated gamma spectra and half-life for, (E)
XENON-135—beta decay of, evaluated gamma spectra and half-life for, (E)
—isomeric transition in, evaluated spectra and half-life for, (E)
XENON-137—beta decay of, evaluated gamma spectra and half-life for, (E)
XENON-138—beta decay of, evaluated gamma spectra and half-life for, (E)
YTTERBIUM-172—energy levels of, Coriolis band-mixing analysis of octupole-vibrational, (T)
ZIRCONIUM-95—beta decay of, evaluated gamma intensities from, (E)
ZIRCONIUM-97—beta decay of, evaluated gamma intensities from, (E) (RWR)

21106 (FRNC-TH-309) MEASUREMENT OF THE g FACTOR OF AN ISOMERIC LEVEL OF ^{117}Sb USING A DPAD METHOD WITH A PULSED MAGNETIC FIELD. Boudard, A. (Universite Scientifique et Medicale de Grenoble (France)). 1972. 72p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

A method for measuring the gyromagnetic ratios of nuclear levels having lifetimes of several hundred microseconds was developed. The DPAD (Disturbed Perturbed Angular Distribution) was improved by subjecting the target to a pulsed magnetic field: the Grenoble cyclotron provides a low-frequency pulsed beam ($T_1 \geq 1$ ms, $T_2 \geq 100$ ns). The method eliminates the limitation existing concerning the target irradiation time and enables the measurements to be performed very much more rapidly for the long half-life levels. The gyromagnetic ratios of the $T_{\frac{1}{2}} = 159$ μs level of ^{115}Sn and the $T_{\frac{1}{2}} = 390$ μs level of ^{117}Sb were measured. The values obtained were respectively 0.255 ± 0.015 and 0.116 ± 0.003. The relaxation times for ^{115}Sn (> 0.2 ms) and for ^{117}Sb (0.64 ± 0.16 ms) were determined in liquid indium. A study of the anisotropy as a function of the temperature of the indium target demonstrated that the relaxation times were very different for a solid and for a liquid indium target. At a temperature of a few degrees below the melting point, the relaxation time is less than 50 μs. A theoretical calculation of the magnetic moment of ^{117}Sb ($T_{\frac{1}{2}} = 390$ μs) led to the choice of a principal configuration which is in agreement with that obtained by Haiser. (FR)

21107 (LYCEN-7263) INELASTIC SCATTERING IN THE CONTINUUM. I. DWBA Analysis of Angular Distribution. Demeyer, A.; Chevarier, A.; Chevarier, N.; Hollinger, G.; Pertosa, P.; Tran Minh Duc (Lyon Univ. (France). Institut de Physique Nucleaire). Oct 1972. 24p. Dep. NTIS (U. S. Sales Only).

A systematic study of inelastic alpha continuum spectra from 15° up to 160° obtained by bombardment of targets in the mass range from ^{51}V up to ^{206}Pb with 55-MeV alpha particles was made. A DWBA analysis suggests the existence of a collective multipole excitation in the continuum. (auth)

21108 (NP-19654) NUCLEAR STRUCTURE STUDIES IN THE TELLURIUM ISOTOPES: THE ^{122}Te(d,p)^{123}Te REACTION. TECHNICAL REPORT 46. Vaagen, J. S.; Oestevold, G.; Lien, J. R.; Graue, A.; Moore, W. H. (Bergen Univ. (Norway). Dept. of Physics). Oct 1972. 36p. Dep. NTIS (U. S. Sales Only).

The energy levels of ^{123}Te have been studied in the ^{122}Te(d,p)^{123}Te reaction at 7.5 MeV bombarding energy using the MIT multiple-gap magnetic spectrograph. More than one hundred levels were observed up to 5.5 MeV excitation energy. Angular distributions were measured and l-assignments, given for 32 of the stronger proton groups. The level scheme was compared with results from IAR and radioactive decay studies. A new $\frac{1}{2}^+$ level was observed at 600 keV. Transition strengths were obtained for orbits in the 50 to 82 neutron shell and compared with pairing theory predictions. A short review is given of the results from (d,p) reactions on the other even-mass Te isotopes, and quasi-particle energies and single-particle energies are calculated from the experimental data. (auth)

21109 (ORNL-TM-4095) DKDATA: SUBROUTINE FOR RETRIEVING RADIONUCLIDE GAMMA-RAY DECAY DATA FROM RSIC DATA SET DLC-19/DECAYGAM. Wachter, J. W. (Oak Ridge National Lab., Tenn.). Feb 1973. Contract W-7405-eng-26. 19p. Dep. NTIS.

DKDATA is a subroutine, written in Fortran IV, which returns to the calling program information concerning the gamma-ray decay characteristics of a nuclide of specified atomic number and mass. These data are initially read from the Radiation Shielding Information Center Data Set DLC-19/DECAYGAM on first entry to the subroutine, and the pertinent data for all nuclides of interest are stored for use in subsequent calls. (auth)

21110 (UCRL-50484(Rev.1)) SEMIEMPIRICAL NEUTRON-INDUCED REACTION CROSS SECTIONS. Alley, W. E.; Lessler, R. M. (California Univ., Livermore. Lawrence Livermore Lab.). 8 Aug 1972. Contract W-7405-eng-48. 234p. Dep. NTIS.

A quick estimate of neutron reaction cross sections for most isotopes from Z = 1 to Z = 83 is given. A graphical portrayal cross sections from 0.025 eV to approximately 15 MeV for 778 neutron-induced reactions is given. Reactions are primarily of the (n, γ), (n, 2n), (n, p), (n, α), and (n, pn) types. Some (n,n*), (n, 3n), (n, 2α), (n, αn), (n, t), and (n, He^3) reactions are included. The reactions considered have parent isotopes that are stable and product half-lives that are greater than 1 min and less than 10^6 yr. Reactions leading to metastable states are also included where applicable. The reliability of the curves varies considerably. Although some of the cross sections are well-known due to the number of data points available, most cross sections are necessarily approximations because of the present lack of data. (auth)

21111 DETERMINATION OF THE ANGULAR MOMENTUM DISTRIBUTION OF HIGHLY EXCITED NUCLEI FROM ISOMER RATIOS FOLLOWING (n,2n) REACTIONS. Winiwarter, P.; Hille, P. (Institut fuer Radiumforschung und Kernphysik, Vienna). Acta Phys. Austr.; 33: No. 3-4, 285-304(1971). (In German).

Both assumptions and limitations of the Vandenbosch–Huizenga method for the determination of spin distribution parameters of isomer ratios after nuclear reactions, especially (n,2n) reactions, were thoroughly examined. For bombardment energies around 15 MeV, all significant data for (n,2n) cross sections of nuclei with a mass larger than 70 were compiled from the literature and were complemented through additional measurements and calculations. Based on the Fermi gas model with fictitious ground state in the formulation of Gilbert and Cameron, spin distribution parameters—reduced to 7 MeV excitation energy—were calculated from the isomer ratios. The comparison with the theory did not use for $\langle m^2 \rangle$ the values of Jensen and Luettinger, as it was often done erroneously. Their values concern the total nucleus, while for the present purpose only the projections of the angular momenta in the neighborhood of the Fermi edge are relevant. With values of 0.086 $A^{\frac{2}{3}}$ for $\langle m^2 \rangle$, spin distribution parameters were obtained which, within the limits of error, agreed well with those derived from the isomer ratios. The spin distribution parameters increase roughly from a value of 3 for the mass 70 to about 5 for heavy nuclei. (1 figure, 1 table, 76 references) (tr-auth)

21112 EFFECT OF COMBINED STATIC AND TIME-DEPENDENT QUADRUPOLE INTERACTIONS ON ANGULAR CORRELATION. Asymmetric Electric Field Gradient Case. Andrade, P. R.; Rogers, J. D. (Rio Grande do Sul Univ., Brazil). Rev. Brasil. Fis.; 1: No. 1, 37-42(Apr 1971).

The form of the perturbation factor for the angular correlation of two successive γ rays is determined when the intermediate state is subject to a nonaxially symmetric static electric field gradient plus a small random time-dependent quadrupole perturbation. The Bloch–Wangness–Redfield theory of nuclear relaxation is applied to calculate the evolution of the density matrix, and a general form of the perturbation factor valid for odd- and even-A nuclei is determined. (auth)

21113 ACTIVATION CROSS SECTION OF CADMIUM ISOTOPES BY 14.8 MeV NEUTRONS. Levkovskii, V. N.; Artem'ev, O. I. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 39-40 (1972). (In Russian).

Eighteen cross sections were measured for Cd isotopes at 14.8 MeV, including (n,p), (n,np), and (n,α) reactions. Seven of these reactions were studied for the first time. Radiochem-

ical separation furnished the necessary enriched Cd isotopes, and a Ge(Li) detector was used to measure the β- and γ-activity. The reactions measured were: ^{103}Cd(n,p); ^{110}Cd(n,p); ^{103}Cd(n,np); ^{111}Cd(n,p); ^{112}Cd(n,p); ^{112}Cd(n,α); ^{112}Cd(n,np); ^{113}Cd(n,p); ^{113}Cd(n,np); ^{114}Cd(n,np); ^{114}Cd(n,α); ^{116}Cd(n,p); ^{116}Cd(n,np); and ^{116}Cd(n,α). (tr-auth)

21114 GAMMA-GAMMA DIRECTIONAL CORRELATIONS IN ^{99}Tc. Bhati, S. S.; Bhardwaj, A. K.; Singh, N.; Mangal, P. C.; Trehan, P. N. (Panjab Univ., Chandigarh, India). J. Phys. Soc. Jap.; 34: No. 1, 1-4(Jan 1973).

Gamma-gamma directional correlation studies were carried out for 740-181, 740-(41)-140, 140-41, and 740-41 keV cascades in ^{99}Tc observed in the radioactive decay of ^{99}Mo. These investigations confirm $3/2^+$ spin assignment for the 921-keV level. The mixing ratios of 740, 140, and 41 keV gamma rays are found to be predominantly E2 + <1% M1, 95% M1 + (5 ± 1)% E2 and predominantly M1 + $(0.7^{+0.5}_{-0.4})$% E2, respectively. (auth)

21115 ESTIMATION OF THE UPPER INTENSITY LIMIT OF THE DIRECT TRANSITION BETWEEN STATES $h_{\bar{11}/2}$ AND $s^+_{1/2}$ IN ^{117}Sn, ^{121}Te, ^{123}Te, AND ^{125}Te NUCLEI. Kalinauskas, R. A.; Makaryunas, K. V.; Davidonis, R. I. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 12: No. 1, 159-166 (1972). (In Russian).

Direct transition lines between shell-model odd neutron states $h_{\bar{11}/2}$ and $s^+_{1/2}$ were sought in the internal conversion electron spectra of the isomeric nuclei ^{117m}Sn, ^{121m}Te, ^{123m}Te, and ^{125m}Te. It was found that the number of such transitions is less than 1.3×10^{-4}, 1.5×10^{-3}, 5.5×10^{-5}, and 1.4×10^{-5}, respectively, in comparison with the full number of the isomeric nuclear decays. In the case of ^{123m}Te the experimental value of the upper intensity limit is 5 times lower in comparison with the intensity resulting from Moszkowski formulas for probability calculation of one-particle transitions. The following experimental upper limit values of the ratio B(E5)/B(M4) of the reduced probabilities for competitive radiative transitions of the multipolarity E5 between states $h_{\bar{11}/2}$ and $s^+_{1/2}$ and that of M4 between states $h_{\bar{11}/2}$ and $d^+_{3/2}$ were found: 12×10^{-25} (^{117}Sn), 19×10^{-25} (^{121}Te) 1.6×10^{-25} (^{123}Te) and 8.2×10^{-25} (^{125}Te). (auth)

21116 MEASUREMENT OF K-SHELL INTERNAL CONVERSION COEFFICIENTS WITH AN X-RAY SCINTILLATION SPECTROMETER. Sahota, H. S. (Punjab Univ., Patiala, India). Indian J. Phys.; 46: No. 2, 86-92(1972).

The K-shell internal conversion coefficients in ^{141}Pr, ^{203}Tl, and ^{198}Hg were determined with a NaI(Tl) scintillation spectrometer by two different methods. In one the main correction factors are determined under experimental conditions, while in the other the correction factors are eliminated by the proper choice of target material and solid angles. The results of the two measurements are in agreement. The wide divergence in the results of different workers using the x-ray peak to gamma ray peak method for the determination of K-conversion coefficients was discussed. (auth)

21117 SPIN ALIGNMENT OF THE GROUND-STATE BAND LEVELS IN Nd AND Sm ISOTOPES EXCITED IN (α,2nγ) REACTIONS. Ejiri, H.; Shibata, T.; Shimizu, A.; Yagi, K. (Osaka Univ.). J. Phys. Soc. Jap.; 33: No. 6, 1515-21(Dec 1972).

Spin alignment of the ground-state band levels of ^{144}Nd, ^{148}Sm, ^{150}Sm, and ^{152}Sm excited in (α,2nγ) reactions is studied in detail by measuring precisely the anisotropy of the intra-ground-state band gamma rays. The degree of the spin alignment increases with the increase of the spin of the ground-state band levels. It depends little on the bombarding energies, the reaction Q values and the structures of the low-lying levels. A simple expression is obtained to describe the degree of the spin alignment in (particle, xnγ) reactions. (auth)

21118 STUDY OF γ-RAY SPECTRUM OF ^{109}Cd. Chatterjee, M. B.; Baliga, B. B. (Saha Inst. of Nuclear Physics, Calcutta). Indian J. Pure Appl. Phys.; 10: No. 7, 517-522(Jul 1972).

A study of the γ-ray spectrum emitted in the decay of ^{109}In (4.3 hr) was made using Ge(Li) and NaI(Tl) detectors, both in singles and in coincidence. Energies and relative intensities of 41 lines of the γ-ray spectrum are reported. On the basis of these γ-ray energies and intensities and from a coincidence study, a level scheme is proposed for ^{109}Cd. (4 figures, 3 tables) (auth)

21119 INHERENT AMBIGUITIES IN GAMMA RAY ANGULAR CORRELATION EXPERIMENTS. Twin, P. J. (Univ. of Liverpool). Nucl. Instrum. Methods; 106: No. 3, 481-492(1973).

Ambiguities in angular correlation experiments, when two spin and mixing-ratio values give similar Legendre coefficients for the initial γ ray, are determined and classified according to the spin difference of initial and final states. The possibility of resolving these inherent ambiguities by the extra information available from the correlation of subsequent γ rays, $\gamma-\gamma$ correlations, and linear polarization correlations is investigated. Many of the ambiguities are never resolved; but, where they can be, it is shown that the simpler experimental measurements of either the angular correlation of subsequent γ rays or the linear polarization of the primary γ ray are the most useful. (4 figures, 2 tables) (auth)

21120 FIT TO EXPERIMENTAL DATA WITH EXPONENTIAL FUNCTIONS USING THE FAST FOURIER TRANSFORM. Schlesinger, J. (State Univ., Mons, Belgium). Nucl. Instrum. Methods; 106: No. 3, 503-508(1973).

The method of Gardner, et al., for fitting experimental data described by a sum of exponentials was improved by the introduction of Fast Fourier Transform techniques. Results from three test cases show the method to be well suited for use on even a small computer. Applications to nuclear and particle physics are suggested. (3 figures) (auth)

21121 EXPERIMENTS ON SEARCH FOR PROTON DECAY FROM THE GROUND STATE. Bogdanov, D. D.; Bochin, V. P.; Karnaukhov, V. A.; Petrov, L. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 5, 890-900(1972). (In Russian).

Neutron-deficient products of reactions caused by accelerated ions of ^{32}S and ^{35}Cl in ^{96}Ru, ^{102}Pd, ^{106}Cd, ^{112}Sn targets were studied. It was found, that when irradiating all the targets, there are produced new emitters of delayed protons in the range from neodymium to holmium. Using two methods it was established, in irradiation of ^{96}Ru with sulfur there is produced proton emitter with the energy 0.83 ± 0.05 MeV with a half-life of about ~1 sec. The yield of this group amounts 10^{-3} of the delayed proton one. An assumption is made, that ~0.83 MeV protons come to existence out of decay of praseodymium (or lanthanum) light isotope from the ground state. (auth)

21122 STUDIES OF WEAK β^--TRANSITIONS IN ^{95}Zr → ^{95}Nb → ^{95}Mo CHAIN. Erten, H. N.; Coryell, C. D. (Massachusetts Inst. of Tech., Cambridge). Radiochim. Acta; 18: No. 1, 39-42(Dec 1972).

The γ-ray spectra of an equilibrium source of 65-d Zr, 90-h ^{95m}Nb, and 35-d ^{95}Nb and separated sources of ^{95}Zr and ^{95}Nb were studied using a compton suppressor attached to an 18-cm^3 Ge(Li) detector. Two weak γ rays of 204- and 585-keV energy, in addition to the well-known γ rays belonging to the decay of these species, were observed. From relative intensity values of these γ rays after correction for conversion 1.7 ± 0.4% and 0.7 ± 0.3% β^- branching values were computed in the decay of 90-h ^{95m}Nb to the 204.2- and 789.2-keV levels in ^{95}Mo, respectively. An upper limit of ≤0.1% β^- branching was set for the β^- decay to the 686-keV level in ^{95}Mo, in the decay of 35-d ^{95}Nb. The decay schemes of 65-d ^{95}Zr, 90-h ^{95m}Nb, and 35-d ^{95}Nb are presented. (3 figures) (auth)

21123 DECAY OF ^{106g}Rh ($T_{1/2}$ = 30s). Marsol, C.; Rahmouni, O.; Ardisson, G. (Institut d'Etudes Nucleaires, Algiers). Compt. Rend., Ser. A, B; 275: No. 21, 805-808(20 Nov 1972). (In French).

Gamma radiation from ^{106g}Rh was measured with Ge(Li) detectors. 167 γ were observed, 78 of them being new. (FR)

21124 GENERALIZED NEUTRON PARTICLE-HOLE STATES IN AN EXTENDED UNIFIED-MODEL DESCRIPTION. Heyde, K. (Rijksuniversiteit, Utrecht); Waroquier, M.; Vanden Berghe, G.; Brussaard, P. J. Phys. Lett.; 43B: No. 1, 1-5(8 Jan 1973).

Negative-parity levels for the even-even N = 82 nuclei, in the energy region 3.5 MeV < E_X < 5.5 MeV, are described in an extended unified model, in terms of neutron hole states coupled to the low-lying states of the N = 83 nuclei. These states are selectively fed in inelastic proton scattering through isobaric analog resonances of the low-lying N = 83 levels. Application is made to the energy spectrum calculation of ^{140}Ce and the partial decay widths to levels in ^{140}Ce. (auth)

21125 INVESTIGATION OF P-ODD INTERACTION IN ^{113}Cd(n,γ)^{114}Cd REACTION. Abov, Yu. G.; Danilov, M. M.; Ermakov, O. N.; (and others) (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 16: No. 6, 1218-1223 (1972). (In Russian).

Further investigation of angular anistropy of emission of γ-quanta with energy 9.04 MeV in ^{113}Cd (n,γ) ^{114}Cd reaction has been carried out with a polarized beam of slow neutrons. The value of the right-left asymmetry without a correction for γ-quantum impurity from transition with energy 8.48 MeV turned out to be equal to $a = (-2.5 \pm 0.9) \cdot 10^{-4}$. An account for possible instrumental asymmetry leads to the value $a = (-2.0 \pm 0.9) \cdot 10^{-4}$. Both values of asymmetry agree with earlier results within the accuracy of measurements. (auth)

21126 DISTRIBUTION OF NEUTRONS IN THE NUCLEAR SURFACE FROM ELASTIC ALPHA-PARTICLE SCATTERING. Bernstein, A. M.; Seidler, W. A. II (Massachusetts Inst. of Tech.,

Cambridge). pp 355-359 of Two-body force in nuclei. Austin, S. M. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on the Two-Body Force in Nuclei; Ann Arbor, Michigan, United States of America (USA) (7 Sep 1971). See CONF-710915-.

An accurate determination of the surface of nuclear density distributions is presented. The measurement of the rms radius relative to ^{40}Ca is achieved to an accuracy of approximately ±0.1 fm. A brief account of the derivation and testing of the model is given, and then it is applied to the differential cross section for scattering of 104-MeV α particles by ^{90}Zr. Agreement is excellent. Preliminary results for the difference of neutron and proton rms radii, $R_n - R_p$, in fermis, for ^{64}Ni, ^{90}Zr, and ^{124}Sn are 0.16 ± 0.16, 0.23 ± 0.11, and 0.09 ± 0.12, respectively. The corresponding R_p values are 3.82 ± 0.02, 4.16 ± 0.03, and 4.60 ± 0.03. It appears that alpha scattering is an accurate method of measuring the density distribution in the nuclear surface. (1 figure, 1 table) (RWR)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 21007, 21105, 21107, 21110–21112, 21117, and 21119.

21127 (BNL-tr-519) MAGNETIC MOMENTS OF ^{168}Er STATES EXCITED BY NEUTRON CAPTURE. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translation by S. J. Amoretty of JINR-P3-6611. 1972. 20p. Dep. NTIS.

Magnetic moments of the neutron resonances in ^{167}Er at 0.460 and 0.584 eV were measured using the technique of neutron transmission through a polarized target. The following values were obtained: $\mu_J(0.460) = (0.9 \pm 0.4)\mu_N$ and $\mu_J(0.584) = (1.8 \pm 0.9)\mu_N$. (auth)

21128 (CALT-63-X-137) NUCLEAR SPECTROSCOPY, X-RAY AND MEDIUM ENERGY PROGRAM. Eighteenth Annual Report for the Period October 1, 1971–September 30, 1972. (California Inst. of Tech., Pasadena. Norman Bridge Lab. of Physics). 15 May 1972. Contract AT(04-3)-63. 401p. Dep. NTIS.

Research progress in fifteen areas during the contract year is briefly discussed. Thirteen reprints (or preprints) are appended. (RWR)

21129 (CEA-N-1563) STUDY OF THE INTERACTION OF RESONANCE NEUTRONS WITH ^{169}Tm. Tellier, H.; Alix, M. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Oct 1972. 30p. (In French). Dep. NTIS (U. S. Sales Only).

The total cross sections measured at high resolution for ^{169}Tm are given. Three different sample thicknesses (0.98, 3.0, and 22.7 g/cm^2) were studied using the 60-MeV Saclay linear accelerator. In order to reduce the Doppler effect, each of the samples was brought to liquid nitrogen temperature. The flight distances used were 53 and 103 meters. Single-level Breit-Wigner parameters were obtained by analyzing the form of the transmission coefficient using the least-squares method. The energy range considered extends up to 2 keV. The mean value of the reduced neutron widths and the total radiative widths were subsequently deduced together with the strength function $S_0 = (1.46 \pm 0.15) \times 10^{-4}$. The spin effect was observed to have no influence on the strength function. The variance of the level spacing distribution is compared with the theoretical values for an orthogonal Gaussian assembly and a random two-body model. (FR)

21130 (TRITA-TFY-72-4) STRUCTURE OF LOW-LYING ROTATIONAL BANDS IN THE NUCLEUS ^{170}Tm. Ogle, W.; Wahlborn, S.; Ryde, H. (Kungliga Tekniska Hogskolan, Stockholm (Sweden); Stockholm Univ. (Sweden). Inst. of Physics). 1972. 38p. INIS.

The data of the 1^- (ground state) and 0^- (first excited) rotational bands in ^{170}Tm are analyzed in the framework of a simple model where these bands are mixed by Coriolis coupling. Due to the symmetry properties of the internal wave functions, the even-I and odd-I members of the 0^- band essentially act as two independent bands. The main intrinsic configuration is assumed to be $\frac{1}{2}^+[411]_p$ $\frac{1}{2}^-[521]_n$. The band-head energies, the Coriolis matrix elements, and the moments of inertia are overdetermined by a fit to the experimental energy levels. The transition data also give information about the band mixing, and, in addition, determine some of the intrinsic M1 and E2 matrix elements. For the intrinsic structure and the mixing of the bands, the result of the analysis shows satisfactory agreement with model calculations and with evidence from adjacent nuclides. The two relevant energy splittings are calculated with a residual neutron–proton interaction, taken to be given by a central, spin- and exchange-dependent potential with Gaussian shape. It is found that with such an assumption one can reproduce the observed energy splittings, although the available parameters are not uniquely determined from the data. (auth)

21131 NUCLEAR DATA SHEETS FOR A = 163. Buyrn, A. (Massachusetts Inst. of Tech., Cambridge, MA). Nucl. Data, Sect. B; 8: No. 4, 295-344(Oct 1972).

Nuclear structure data for mass-163 nuclei are compiled, and adopted level and gamma-ray properties are presented. The adopted values are based on all data received before June 1972. (auth)

21132 LONG-LIVED REDUCTIONS IN RECOILLESS FRACTIONS FOLLOWING COULOMB EXCITATION. Wender, S. A.; Hershkowitz, N. (Univ. of Iowa, Iowa City). Phys. Rev. Lett.; 29: No. 25, 1648-51(18 Dec 1972).

Time-independent reductions in recoilless fractions were observed in the Mössbauer effect following simultaneous Coulomb excitation of the first excited states of ^{183}W and ^{182}W in WO_3. These results are not in agreement with models predicting only a local temperature increase following excitation, but can be understood in terms of long-lived radiation damage effects. (auth)

21133 DECAY OF ^{182}Ta. Galan, P. (Inst. of Physics, Bratislava); Vejs, M. Fyz. Cas.; 22: No. 1/2, 60-76(1972).

The gamma-ray spectrum from the decay of ^{182}Ta was measured using a Ge(Li) spectrometer. Both the relative and the absolute intensities of 32 gamma transitions were determined, and the existence of a new transition with an energy of 1180.9 keV was confirmed. A new level at the energy of 1510.21 keV was introduced. Absolute intensities of the beta transitions with the respective experimental values of log ft were determined on the basis of the intensity balance. (auth)

21134 INDIRECT PROCESSES IN SINGLE-NEUTRON TRANSFER REACTIONS ON RARE-EARTH DEFORMED NUCLEI. McVay, L. J.; Ascuitto, R. J.; King, C. H. (Yale Univ., New Haven). Contract AT(11-1)-3074. Phys. Lett.; 43B: No. 2, 119-122(22 Jan 1973).

High-resolution data on the ^{171}Yb(d,p)^{172}Yb reaction at E_d = 11.2 MeV are presented and compared with similar data on the inverse ^{172}Yb(p,d)^{171}Yb reaction. Coupled-channels calculations reproduce the ground-band angular distribution much better than the DWBA results do. (auth)

21135 M2 TRANSITIONS IN ^{180}W AND ^{182}W. Erbil, H. H.; Piepenbring, R. (Institut des Sciences Nucleaires, Grenoble, France). Phys. Lett.; 43B: No. 1, 23-24(8 Jan 1973).

M2 transitions from 2^- states to the ground state are calculated in even W nuclei. The results obtained from a model including pairing and octupole vibrations are compared with the experimental results. Good agreement is obtained. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 19857, 21007, 21081, 21101, 21105, 21107, 21110, 21111, 21116, 21119, 21120, 21148, 21169, 21178, 21188, 21223, 21225, and 21241.

21136 (JINR-E6-6808) HIGHLY EXCITED ISOMER IN ^{200}Bi. Kaun, K. H.; Neubert, W.; Schulze, W.; Stary, F.; Peker, L. K.; Volmyanskii, E. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1972. 13p. (In Russian). Dep. NTIS (U. S. Sales Only).

A highly excited isomeric state with 2242 keV excitation energy and a half-life of 46 ± 3 ns was found by in-beam γ spectroscopy with the ^{193}Ir(^{12}C,5n)^{200}Bi reaction. The calculated four-particle matrix elements suggest that this state belongs to the configuration $\pi(h_{9/2})^1\ \nu(p_{1/2})^{-1}\ \nu(i_{13/2})^{-2}$. (auth)

21137 (JINR-E6-6809) HIGH-SPIN ISOMER IN ^{204}Bi. Kaun, K. H.; Neubert, W.; Schulze, W.; Stary, F.; Rakivnenko, Yu. N.; Klyucharev, A. P.; Lutsik, V. A.; Skakun, E. A.; Romanii, I. A.; Peker, L. K.; Volmyanskii, E. I. (Joint Inst. For Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1972. 8p. (In Russian). Dep. NTIS (U. S. Sales Only).

By making use of heavy-ion and alpha-particle reactions an isomeric state was found in the ^{204}Bi nucleus, which has a half-life of $T_{\frac{1}{2}}$ = 1.1 ms and the quantum characteristics $I^\pi = 16^+$. The four-quasi-particle configuration $\nu(i_{13/2})^{-2}\nu(f_{5/2})^{-1}\ \pi(h_{9/2})^1$ was ascribed to this state. (2 figures, 1 table) (auth)

21138 (LYCEN-7231) ELECTROMAGNETIC PROPERTIES OF THE 2^+ STATES OF ^{192}Pt, ^{194}Pt, AND ^{196}Pt ISOTOPES. Lhersonneau, G. (Lyon Univ. (France). Institut de Physique Nucleaire). Jul 1972. 49p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The lifetimes of the first two excited 2^+ states of ^{196}Pt were measured using the $\gamma\beta^-$ delayed-coincidence method. The lifetime found for the first state, $\tau_{2^+} = 43.6 \pm 3.0$ ps, is in agreement with measurements made using the Coulomb excitation method. The accuracy achieved in determining this lifetime and the g factor of the corresponding state was improved by a factor of 1.4. The following (unpublished) result is given for the 2nd state: $\tau_{2'+} = 52 \pm 6$ ps. It was also possible to demonstrate that the 689-keV transition of ^{196}Pt is much weaker than previously supposed. Measurements established the sense of the changes in the $B(E3, 2' \rightarrow 2)/B(E2, 2 \rightarrow 0)$ and $B(E2, 2' \rightarrow 0)/B(E2, 2 \rightarrow 0)$ ratios of the ^{192}Pt, ^{194}Pt, and ^{196}Pt isotopes. It is shown how the anharmonic phenomenological model of G. Alaga can account for this evolution with the appropriate weighting of the anharmonic terms for the different isotopes. The values obtained for the gyromagnetic ratios for the first two excited states of the ^{192}Pt and ^{194}Pt nuclei and for the first excited state of ^{196}Pt nucleus are in good agreement with the results obtained using the Greiner magnetic operator in the framework of the anharmonic model. (FR)

21139 (N-72-22692) EFFECT OF MULTIPLE SPIN SPECIES ON SPHERICAL-SHELL NEUTRON-TRANSMISSION ANALYSIS. Semler, T. T. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Apr 1972. 13p. (NASA-TM-X-2546; E-6806). NTIS.

A series of Monte Carlo calculations were performed in order to evaluate the effect of separated against merged spin statistics on the analysis of spherical shell neutron transmission experiments for gold. It is shown that the use of separated spin statistics results in larger average capture cross sections of gold at 24 keV. This effect is explained by stronger windows in the total cross section caused by the interference between potential and J(+) resonances and by J(+) and J(-) resonance overlap allowed by the use of separated spin statistics. (STAR)

21140 EFFECTS OF NUCLEON PAIRING IN SOME EVEN-EVEN NUCLEI. Itkis, M. G.; Kuvatov, K. G.; Okolovich, V. N.; Rus'kina, G. Ya. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 40-3(1972). (In Russian).

The anisotropy of fragments was measured for the fission of ^{194}Pt, ^{204}Pb, ^{206}Po, and ^{208}Pb by α particles with energies of 29 to 38 MeV. Values were obtained for the critical energy of phase transition for nuclei and the fission energy in the transition state. A weak dependence of the pair-interaction constant of nucleons on nuclear deformation was demonstrated. (tr-auth)

21141 EVIDENCE FOR 15^- AND 11^+ ISOMERIC STATES OF THE $\pi(h_{9/2})^2 I_{13/2})_{8^+} \nu(p_{1/2})^{-1}$ AND $\pi(h_{9/2})^3_{\frac{1}{2}} \nu(p_{1/2})^{-1}$ CONFIGURATIONS IN ^{210}At. Wikstroem, K.; Fant, B.; Filevich, A.; (and others). (Forskningsinstitutet foer Atomfysik, Stockholm). Phys. Scr.; 5: No. 3, 126-8(1972).

Two isomeric states in ^{210}At, having half-lives 0.75 ± 0.10 μs and 27 ± 3 ns at energies 2549.4 and 1363.2 keV, respectively, were found in the ^{209}Bi$(\alpha,3n)^{210}$At reaction. The 2549-keV state decays to the 5^+ ground state mainly via a cascade of five gamma rays having energies 644.4, 541.8, 111.3, 675.5, and 576.4 keV, which are suggested to be emitted from states having spins and parities 15^-, 12^+, 11^+, 9^+, and 7^+, respectively. All states observed in the decay of the 15^- state, except two at 576 and 507 keV, are suggested to arise from the coupling of the $p_{\frac{1}{2}}$ neutron hole to the known levels in ^{211}At having the configurations $(h_{9/2})^2 i_{13/2}$, $(h_{9/2})^2 f_{5/2}$ and $(h_{9/2})^3$. It would seem most likely that the 576 and 507 keV levels have spins 7^+ and 6^+, respectively, and that they are probably members of the $\pi(h_{9/2})^3_{\frac{1}{2}} - \nu(f_{5/2})^{-1}$ configuration and correspond to the 651 keV 7^+ and 510 keV 6^+ levels of the $\pi(h_{9/2}) \nu(f_{5/2})^{-1}$ configuration in ^{208}Bi. Recent measurements of the g-factor of the 15^- state give a value 1.03 ± 0.02 to be compared with 1.06 ± 0.03, which can be calculated for the assumed configuration for this state. (auth)

21142 TRANSITIONS IN ^{199}Hg. Singh, H.; Sethi, B.; Tikku, V. K.; Mukherjee, S. K. (Saha Inst. of Nuclear Physics, Calcutta). Radiochem. Radioanal. Lett.; 12: No. 2-3, 191-9(29 Nov 1972).

The decay of 3.1-d ^{199}Au was studied using a high-resolution Ge(Li) x-ray detector. The ^{199}Au activity was obtained by radiochemical extraction from thermal neutron-irradiated Pt metal. An improved decay scheme of ^{199}Au to levels in ^{199}Hg is proposed. The lifetime of the 208.16-keV level in ^{199}Hg was found to be 70 ± 15 psec. The comparison of the transition rates deduced from the measurements with Weisskopf's single-particle estimate and the comparison of the experimental magnetic moment with the corresponding model-dependent value reveal that the first three levels in ^{199}Hg may be described by the core-excitation model. (auth)

21143 ^{209}Pb SINGLE-NEUTRON STATES AND THE $l = 4$ LEVELS OF ^{205}Pb STUDIED BY THE (d Vector,p) REACTION. Casten, R. F.; Cosman, E.; Flynn, E. R.; (and others) (Los Alamos Scientific Lab., NM). Nucl. Phys.; A202: No. 1, 161-179 (1973).

Differential cross sections and vector and tensor analyzing powers were measured for the (d,p) reaction to the single-particle states of ^{209}Pb with spins ranging from $1/2$ to $15/2$. Distorted-wave calculations were compared to all of these results, and reasonable agreement was obtained with the cross sections and vector analyzing powers but not the tensor analyzing powers. The d and g vector analyzing powers for the spin-orbit partners were found to have opposite signs, and this fact was used to assign $g_{9/2}$ spin to three $l = 4$ states seen near 2.6 MeV in ^{205}Pb. (auth)

21144 STUDY OF THE ^{194}Tl DECAY. Amov, B.; Vandlik, T.; Vandlik, Ya.; Vylov, Ts.; Zhelev, Zh.; Zaitseva, N. G.; Penev, I.; Tyrroff, Kh. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 5, 881-889(1972). (In Russian).

The decay of mass-separated ^{194}Tl is studied by using the spectrometers with Ge(Li)- and Si(Li)-detectors and cooled field transistors. Gamma-ray spectra and those of conversion electrons are also studied. A number of new transitions are observed, a_K for 26 γ-transitions is determined. New states are introduced into the decay mode. (auth)

21145 ENERGY DEPENDENCE OF THE ISOSPIN PART OF THE OPTICAL POTENTIAL. Woods, T. J. (Univ. of Minnesota, Minneapolis). pp 307-312 of Two-body force in nuclei. Austin, S. M. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on the Two-Body Force in Nuclei; Ann Arbor, Michigan, United States of America (USA) (7 Sep 1971). See CONF-710915-.

The optical potential is examined to show that the isospin part has an energy dependence. The ^{208}Pb(p,n)^{208}Bi (IAS) reaction was measured at 24.8, 30.5, and 38.6 MeV, and normalized DWBA fits were made to the differential cross sections obtained. The "best fit" parameters of Becchetti and Greenlees (energy-independent) described the shapes of the angular distributions well. The calculated excitation function for the reaction at 25.2 to 47.3 MeV, on the other hand, showed distinctly nondirect-reaction characteristics, in contrast with the data. Other DWBA excitation functions were calculated in which the isospin potential was assumed to have a linear energy dependence. These agreed more closely with the data, but there were still discrepancies. One can conclude that, if the energy dependence is not nonlinear, either there are insufficient low-energy data to allow definite conclusions or threshold effects influence the energy dependence. In any event, the energy dependence of the isospin potentials is definitely indicated. (2 figures, 1 table) (RWR)

21146 NUCLEAR DATA SHEETS FOR A = 195. Martin, M. J. (Oak Ridge National Lab., TN). Nucl. Data, Sect. B; 8: No. 5, 431-476(Nov 1972).

Detailed level schemes and the experimental reaction and decay data on which they are based are presented for all the nuclei with mass number A = 195. The experimental data are evaluated, inconsistencies and discrepancies are noted, and adopted values for level and gamma energies, gamma intensities, and other nuclear properties are given. Conclusions regarding spin assignments as well as some configuration assignments are presented. Level schemes for each of the A = 195 nuclei are presented first. Then for each nucleus the experimental data are presented, followed by a summary of level properties, γ-ray properties, and compilers' comments. All data received before November 1972 were included. (auth)

21147 NUCLEAR DATA SHEETS FOR A = 193. Lewis, M. B. (Oak Ridge National Lab., TN). Nucl. Data, Sect. B; 8: No. 5, 389-429(Nov 1972).

Level schemes, spin and parity assignments, and decay properties are presented for all nuclei with mass number A = 193. Experimental data and adopted values are given along with conclusions as to the spin and parity assignments. The presentation of the nuclear properties is given in the light of the data and current theoretical ideas. In this transition region, level decay rates are seen to be of particular importance and so are summarized in terms of multipole enhancement or hindrance. The compilers attempted to bring out some inconsistencies in the data and resolve discrepancies when possible. Deficiencies in the data include reaction data leading to ^{193}Pt, rigorous spin assignments for ^{193}Pt,

and reaction data leading to ^{193}Au. An abundance of data on stable ^{193}Ir shows that nuclear deformations are already a prominent characteristic in this transitional nucleus. Level schemes for each of the A = 193 nuclei are presented first. Then for each nucleus are presented the experimental data, usually followed by a summary of level properties, gamma or transition rate properties, and comments on the ground-state decay scheme. Adopted level and decay properties are based on data received before June 1972. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 19859, 19886, 21007, 21043, 21110, 21119, 21186, 21228, and 21591.

21148 (AAEC/TM-631) TABLES OF ENERGIES OF ALPHA EMITTING NUCLIDES FOR USE IN ALPHA SPECTROMETRY. Porritt, R. E. J.; Kelly, J. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Oct 1972. 53p. Dep. NTIS (U. S. Sales Only).

Tables of the energies of alpha-emitting nuclides are presented in a form suitable for the identification of the nuclides in alpha spectra. The first table lists these nuclides in increasing energy order, the second table lists them in alphabetical order of their chemical symbols, and the third table is a series of charts showing the genetic relationships in their decay schemes. (3 tables) (auth)

21149 (ANCR-1088, pp 1-45) NEUTRON INTERACTIONS WITH NUCLEI. Oct 1972.

In Nuclear Technology Division annual progress report for period ending June 30, 1972.

AMERICIUM-243—neutron reactions at 0.5 to 250 eV, resonance parameters from, (E)
—neutron resonance absorption integrals at 0.5 to 1000 eV, (E)
CURIUM-244—neutron reactions up to 521 eV, resonance parameters from, (E)
—neutron resonance absorption and fission integrals for, (E)
FISSION PRODUCTS—reactivity of, measurements of
IRON—neutron reactions at 24.5 to 352 keV, transmission measurements of total cross section for, (E)
NUCLEI—neutron capture by A = 88 to 159, integral cross sections for, (E)
PLUTONIUM-242—neutron reactions at 23 to 495 eV, resonance parameters from, (E)
PROMETHIUM—separation from samarium, method for
PROMETHIUM-147—neutron reactions with, cross section for, (E)
URANIUM-235—neutron resonance integrals and parameters to 82 eV, (E)
—neutron fission at 8.8 to 56 eV, anisotropies and relative yields of high-energy fragments from, (E) (RWR)

21150 (ANL-Trans-936) ANGULAR DISTRIBUTION OF FRAGMENTS OF SPONTANEOUSLY FISSIONING ISOMERS. Gangrskii, Yu. P.; Nguyen Kong Khanh; Pulatov, D. D.; Pham Zuy Hien (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). Translation of JINR-P7-6466. 22 May 1972. 10p. Dep. NTIS.

There were measured the angular distributions of the fragments of the spontaneously fissioning isomers ^{236}Pu, ^{237}Pu and ^{243}Cm, produced in α-particle reactions. Anisotropy of the angular distribution was observed for ^{236}Pu and ^{237}Pu isomers. The effect of the neutrons and of γ quanta emitted from the compound nucleus, as well as of extranuclear magnetic poles, on the angular anisotropy is discussed. (5 figures, 1 table) (auth)

21151 (JUL-879-NP) ISOMERS AMONG THE PRIMARY FISSION PRODUCTS OF ^{235}U AFTER THERMAL FISSION. Grueter, J. W. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Neutronenphysik). Aug 1972. 108p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Cologne Univ. (West Germany).

Highly excited, neutron-rich nuclides are produced in the fission of ^{235}U. The excitation of the nuclei is reduced by neutron and gamma emission as well as by beta decay. Part of the gamma radiation is emitted with half-lives that are characteristic of isomers. The purpose of the present study was to identify the emitters of these longer-lived transitions and to reveal as far as possible the origin of the isomeric radiation. The main part of the work consists of detailed and time-consuming investigations of the level structure of certain individual emitters. The report is divided into two parts, the first one describing the method of nuclide identification and the measuring devices, the second part discussing the level structure of the emitters. An attempt is made to interpret this isomerism. Moreover, some conclusions with regard to the collective structure of the A ~ 100 region are given. (30 figures, 4 tables) (GF)

21152 (STI/PUB-329) PROMPT FISSION NEUTRON SPECTRA. Panel Proceedings Series. Proceedings of a Consultants' Meeting Held in Vienna, August 25-27, 1971. (International Atomic Energy Agency, Vienna (Austria)). Oct 1972. 181p. (CONF-710845). IAEA $6.00.

Separate abstracts were prepared for fourteen of the papers in these proceedings. The remaining one has already appeared in NSA as 26: 37527. (RWR)

For abstracts of individual papers see: 21155-21165, 21186, 21187, and 21586.

21153 DETERMINATION OF SPONTANEOUS FISSION OF ^{238}U BY MEASUREMENT OF THIRD-ORDER CORRELATION FUNCTIONS. Thury, Wolfgang M. (Technische Hochschule, Graz). Acta Phys. Austr.; 33: No. 3-4, 375-88(1971). (In German).

Through measurements of third-order correlation functions, the spontaneous fission rate of uranium is determined in the Siemens Argonaut reactor at Graz. The advantages which the "modified" Rossi alpha experiments (which measure triple coincidences) possess over the Rossi α experiments of Orndoff (which measure double coincidences) are discussed. (6 figures) (tr-auth)

21154 FRACTIONAL INDEPENDENT YIELDS OF ^{111m}Pd AND ^{112}Ag FROM THERMAL-NEUTRON-INDUCED FISSION OF ^{249}Cf. Troutner, D. E.; Harbour, R. M. (Savannah River Lab., Aiken, SC SC). J. Inorg. Nucl. Chem.; 35: No. 1, 11-17 (Jan 1973).

The fractional independent yields of ^{111m}Pd and ^{112}Ag from thermal-neutron-induced fission of ^{249}Cf were measured. The yields of ^{111m}Pd and ^{112}Ag are 0.083 ± 0.005 and 0.035 ± 0.008, respectively. The yield of ^{111m}Pd is consistent with an isomer yield ratio for which the low-spin ground state isomer ^{111g}Pd is favored. (auth)

21155 FISSION NEUTRON SPECTRA: PERSPECTIVE AND SUGGESTION. Smith, A. B. (Argonne National Lab., IL). pp 3-18 of Prompt Fission Neutron Spectra. Vienna; International Atomic Energy Agency (1972).

From Proceedings of a Consultants' Meeting on Prompt Fission Neutron Spectra; Vienna, Austria (25 Aug 1971). See STI-PUB-329; CONF-710845-.

Recently reported macroscopic and spectrum-average measurements and the analysis of fast-critical experiments have suggested an uncertain knowledge of prompt-fission-neutron spectra. These suggestions rekindled the author's long-term interest in the fission spectrum. Specifically, the applied importance of these uncertainties stimulated additional work at this Laboratory with the objective of testing certain of the postulates put forth as the result of the macroscopic studies. In preparation for new experimental work the status of prompt-fission-neutron spectra was assayed, and the results of that survey received a limited distribution. The pertinent experimental work at this Laboratory is now complete. Essentially concurrently a number of new experimental results have become available at other laboratories. In the resumé the present status of prompt-fission-neutron spectra is outlined, including both the new and the older results. Primary emphasis is given to basic microscopic information with attention to associated experimental problems and limitations. (1 figure, 8 tables, 72 references) (auth)

21156 REVIEW OF PROMPT FISSION NEUTRON SPECTRUM DATA FOR ^{235}U AND ^{239}Pu NEUTRON-INDUCED FISSION AND ^{252}Cf SPONTANEOUS FISSION. Koster, A. (International Atomic Energy Agency, Vienna). pp 19-28 of Prompt Fission Neutron Spectra. Vienna; International Atomic Energy Agency (1972).

From Proceedings of a Consultants' Meeting on Prompt Fission Neutron Spectra; Vienna, Austria (25 Aug 1971). See STI-PUB-329; CONF-710845-.

The major differential measurements of prompt fission neutron spectra are reviewed and an estimate of the average energy of the spectra of ^{235}U and ^{239}Pu for thermal-neutron fission and of ^{252}Cf for spontaneous fission is given. Only for ^{235}U were enough experimental data available to allow a fitting by an orthogonal polynomial function. Discrepancies in the existing data are pointed out particularly for ^{252}Cf. (3 tables) (auth)

21157 BRIEF REVIEW OF INTEGRAL MEASUREMENTS WITH FISSION SPECTRUM NEUTRONS. Grundl, J. A. (National Bureau of Standards, Washington, DC). pp 29-32 of Prompt

Fission Neutron Spectra. Vienna; International Atomic Energy Agency (1972).

From Proceedings of a Consultants' Meeting on Prompt Fission Neutron Spectra; Vienna, Austria (25 Aug 1971). See STI-PUB-329; CONF-710845-.

The paper is an edited transcript of the introduction to the discussion of integral measurements of fission cross sections averaged over fission spectra given by the author at the meeting. (1 table) (auth)

21158 DISCREPANCIES BETWEEN INTEGRAL AND DIFFERENTIAL MEASUREMENTS OF THE PROMPT FISSION NEUTRON ENERGY SPECTRUM. Campbell, C. G.; Rowlands, J. L. (United Kingdom Atomic Energy Authority, Dorchester, Eng.). pp 33-39 of Prompt Fission Neutron Energy Spectra. Campbell, C. G.; Rowlands, J. L. (United Kingdom Atomic Energy Authority, Dorchester, Eng.). pp 33-39 of Prompt Fission Neutron Spectra. Vienna; International Atomic Energy Agency (1972).

From Proceedings of a Consultants' Meeting on Prompt Fission Neutron Spectra; Vienna, Austria (25 Aug 1971). See STI-PUB-329; CONF-710845-.

The results of recent differential measurements of the fission spectra of ^{235}U and ^{239}Pu are summarized, and discrepancies between these measurements and values deduced from integral measurements are discussed. It is recommended that the differential measurements should be reevaluated to determine the best shape for the spectrum and the uncertainty in the shape and that the different activation measurements made in a fission spectrum should be evaluated and discrepancies identified. It is also recommended that further measurements of the average value of the ^{238}U fission cross section in a ^{235}U thermal fission spectrum should be made. (4 tables) (auth)

21159 FISSION NEUTRON ENERGY SPECTRA INDUCED BY FAST NEUTRONS ON ^{238}U, ^{235}U, AND ^{239}Pu. Knitter, H. H.; Coppola, M.; Islam, M. M.; Ahmed, N.; Jay, B. (EURATOM, Geel, Belg.). pp 41-57 of Prompt Fission Neutron Spectra. Vienna; International Atomic Energy Agency (1972).

From Proceedings of a Consultants' Meeting on Prompt Fission Neutron Spectra; Vienna, Austria (25 Aug 1971). See STI-PUB-329; CONF-710845-.

Measurements of fission-neutron energy spectra induced by fast neutrons on ^{238}U, ^{235}U, and ^{239}Pu using time-of-flight technique are presented. The average fission neutron energies were calculated from the time-of-flight spectra of ^{238}U at incident neutron energies of 1.9 and 2.3 MeV, of ^{235}U at 0.14, 0.40, 1.5, 1.9, and 2.3 MeV, and of ^{239}Pu at 1.5, 1.9, 2.3, 4.0, 5.0, and 5.5 MeV. Their values were compared with the theoretical predictions of Terrell. The angular distributions of the fission neutrons were also evaluated in some cases to look for any anisotropy in their emission. (12 figures, 4 tables) (auth)

21160 MEASUREMENT OF THE PROMPT FISSION NEUTRON SPECTRUM OF ^{235}U AT 0.5-MeV INCIDENT NEUTRON ENERGY: TENTATIVE RESULTS. Johansson, P. I.; Almen, E.; Holmqvist, B.; Wiedling, T. (Atomic Energy Co., Studsvik, Sweden). pp 59-64 of Prompt Fission Neutron Spectra. Vienna; International Atomic Energy Agency (1972).

From Proceedings of a Consultants' Meeting on Prompt Fission Neutron Spectra; Vienna, Austria (25 Aug 1971). See STI-PUB-329; CONF-710845-.

The shapes of fission-neutron spectra are of interest for power reactor calculations. Recently it has been suggested that the neutron-induced fission spectrum of ^{238}U should be harder than was earlier assumed. For this reason measurements of the neutron spectra of some fissile isotopes are in progress at this laboratory. The report presents results from a current study of the energy spectra of the neutrons emitted in the neutron-induced fission of ^{235}U. The measurements were performed at an incident neutron energy of 0.53 MeV by using time-of-flight techniques together with pulse-shape discrimination in the neutron detector system to suppress the gamma background. The detector was calibrated with respect to energy and efficiency from 0.5 to 14 MeV: this calibration enabled the fission spectrum to be analyzed over a much larger energy range than in any previous investigation of the ^{235}U spectrum. Corrections for the effect of neutron attenuation in the uranium sample were calculated by using a Monte Carlo program. The fission neutron spectrum was analyzed on the basis of energy distributions according to Maxwell and Watt, and it was shown that Watt's distribution is more useful than Maxwell's for describing the spectrum. (3 figures) (auth)

21161 FISSION NEUTRON SPECTRUM MEASUREMENT OF ^{252}Cf. Jeki, L. (Central Research Inst. for Physics, Budapest); Kluge, G.; Lajtai, A.; Dyachenko, P. P.; Kuzminov, B. D. pp 81-87 of Prompt Fission Neutron Spectra. Vienna; International Atomic Energy Agency (1972).

From Proceedings of a Consultants' Meeting on Prompt Fission Neutron Spectra; Vienna, Austria (25 Aug 1971). See STI-PUB-329; CONF-710845-.

The spontaneous fission neutron spectrum of ^{252}Cf was measured from 0.002 to 1 MeV by the time-of-flight technique. The experimental points fit a Maxwellian with T = 1.3 MeV. (3 figures, 1 table) (auth)

21162 DELAYED NEUTRONS FROM SPONTANEOUS FISSION OF ^{252}Cf. Nefedov, V. N.; Melnikov, A. K.; Starostov, B. I. Scientific Research Inst. of Atomic Reactors, Melekess, USSR). pp 89-96 of Prompt Fission Neutron Spectra. Vienna; International Atomic Energy Agency (1972).

From Proceedings of a Consultants' Meeting on Prompt Fission Neutron Spectra; Vienna, Austria (25 Aug 1971). See STI-PUB-329; CONF-710845-.

The total neutron spectrum resulting from spontaneous fission of ^{252}Cf was measured by using the time-of-flight method with long flight paths. In addition, direct measurements were made by the delayed-coincidence method to determine the number and time of emission of delayed neutrons. The results confirm earlier observations of fission neutrons emitted about 10^{-9} to 10^{-8} s after scission. (6 figures, 2 tables) (auth)

21163 DIFFERENCE OF MICROSCOPIC INTEGRAL CROSS-SECTION RATIOS IN THE ^{235}U AND ^{239}PU THERMAL FISSION NEUTRON SPECTRA. Fabry, A. (CEN/SCK, Mol, Belg.). pp 97-106 of Prompt Fission Neutron Spectra. Vienna; International Atomic Energy Agency (1972).

From Proceedings of a Consultants' Meeting on Prompt Fission Neutron Spectra; Vienna, Austria (25 Aug 1971). See STI-PUB-329; CONF-710845-.

For three threshold reactions commonly used in reactor dosimetry and whose energy coverage encompasses the range 1 to 10 MeV, the differences of microscopic integral cross-section ratios measured in the ^{239}Pu and ^{235}U thermal fission neutron spectra are inconsistent with the current interpretation of the published ratios of the differential neutron spectra, and tend to confirm earlier independent integral studies. The experiment is described, and its difficulties are outlined. (1 figure, 4 tables) (auth)

21164 MEASUREMENT OF THE AVERAGE FISSION CROSS-SECTION RATIO, $\bar{\sigma}_f(^{235}U)/\bar{\sigma}_f(^{238}U)$, FOR ^{235}U AND ^{239}Pu FISSION NEUTRONS. Grundl, J. A. (National Bureau of Standards, Washington, DC). pp 107-111 of Prompt Fission Neutron Spectra. Vienna; International Atomic Energy Agency (1972).

From Proceedings of a Consultants' Meeting on Prompt Fission Neutron Spectra; Vienna, Austria (25 Aug 1971). See STI-PUB-329; CONF-710845-.

Average fission cross-section ratios, $\bar{\sigma}_f(^{235}U)/\bar{\sigma}_f(^{238}U)$, were measured for ^{235}U and ^{239}Pu fission neutrons. A cavity fission source, a fission ionization chamber, and a redundant determination of fission foil weight ratios were employed for the measurements. The result for ^{235}U fission neutrons is 3.71 ± 0.17, a value that confirms earlier integral microscopic results and is 12 to 20% discrepant with predictions based on differential microscopic data. The observed ratio of average cross-section ratios, χ_{49}/χ_{25}, is 0.970 ± 0.012. This value represents a departure from unity that is less than one-half of that predicted by differential microscopic data. The measurements described remain in progress. (auth)

21165 INTEGRAL CHECK OF THE FISSION NEUTRON SPECTRUM THROUGH AVERAGE CROSS-SECTIONS FOR SOME THRESHOLD REACTIONS. Kimura, I.; Kobayashi, K.; Shibata, T. (Kyoto Univ.) pp 113-128 of Prompt Fission Neutron Spectra. Vienna; International Atomic Energy Agency (1972).

From Proceedings of a Consultants' Meeting on Prompt Fission Neutron Spectra; Vienna, Austria (25 Aug 1971). See STI-PUB-329; CONF-710845-.

Average cross sections for some threshold reactions were measured in the core of the Kyoto University Reactor (KUR) and with a fission plate of enriched uranium. Making use of these results and energy-dependent cross section data, an integral check of the fission neutron spectrum was carried out. The results support the authenticity of the forms given by earlier workers. (6 figures, 19 tables)

21166 NUCLEAR STRUCTURE SYSTEMATICS FOR $A \geq 229$. Ellis, Y. A.; Schmorak, M. R. (Oak Ridge National Lab., TN). Nucl. Data, Sec. B; 8: No. 4, 345-387(Oct 1972).

Log-ft values for β and electron-capture transitions and experimental hindrance factors for α decays are presented for the $A \geq 229$ mass region in a systematic way. For some favored and hindered α transitions, comparisons of experimental hindrance factors with theoretical calculations are made. Band-head energies and rotational band parameters are given. Measured magnetic moments of odd-A nuclei are compared with those calculated

using Nilsson wavefunctions. Experimental B(E2)↑ values to first 2^+ states in even–even nuclei are plotted as a function of mass number. (21 figures, 14 tables) (auth)

21167 RESONANCE PARAMETERS OF ^{240}Pu. Weigmann, H.; Theobald, J. P. (Commission of the European Communities, Geel, Belgium). J. Nucl. Energy; 26: No. 12, 643-645(Dec 1972).

Earlier data on resonance parameters which included measurements of total, capture, and elastic scattering cross sections used values of normalization resonance which were recently disproved. The data were reanalyzed using new parameters for the 20-eV resonance. The effect of the changes in these parameters is discussed, and essential results are tabulated. (UK)

21168 ^{237m_f}Pu DOUBLE FISSION ISOMER STUDY THROUGH THE ^{237}Np(d,2n) REACTION IN THE E_d = 9 TO 12 MeV ENERGY RANGE. Vilcov, N.; Griffith, G.; Vilcov, I.; Leachman, R. B. (Kansas State Univ., Manhattan). Rev. Roum. Phys.; 17: No. 9, 1031-9(1972).

The apparent constancy of the isomer production cross section ratio for the two fission isomers of ^{237m_f}Pu may be explained under the following assumptions: (a) There are no transitions between nuclear states with different deformations. (b) The particle (neutron)emission is forbidden by energetic reasons. (c) The radiative width and the total penetration width are comparative for the upper isomeric state. By using the kinetic equations, the spin pair $J_L = 1/2$ (ground state in the second well) and $J_S = 3/2$ (5/2) (excited state in the second well) could explain the experimental data. In a simple physical image the above situation corresponds to the feeding of lower (low-spin) isomeric state through the gamma decay from the upper (high-spin) state one ($\Gamma_\gamma \gg \Gamma_S$, $R \gg 1$), opposite to the mechanism proposed corresponding to the population of the two isomeric states with the weights given by the isomeric yield ratio ($\Gamma_\gamma \simeq 0$, $R \simeq 1$). The actual precision of experimental data does not allow to choose between the two possibilities. A crucial experiment might be the study of population of the double fission isomers of ^{237}Pu in the ^{238}Pu (γ,n) reaction, due to the very low value ($\hbar$) of the angular momentum of the compound nucleus. Such experiment is planned for the near future. (auth)

21169 CORRELATIONS OF NUCLEAR AND CHEMICAL PERIODICITY. Gordeev, G. P. Zh. Obshch. Khim.; 42: No. 11, 2359-2368(Nov 1972). (In Russian).

Simple numerical relationships were detected for atomic and nuclear properties based on a short form of the periodic table. Under the irregular chemical periodicity of the elements lay a similar nuclear periodicity, regular with respect to the mass relationships, the period consisting of 21 nucleons. The average binding energy per nucleon and the weighted values of the isotope number were shown to be functions of the atomic weight of the elements. A dependence of total α-decay energy of heavy nuclei on the mass number of the latter is discussed. (2 references). (KSW)

21170 YIELDS OF FIRST AND SECOND DELAYED NEUTRON GROUPS IN NEUTRON FISSION OF ^{237}Np AND ^{241}Am. Sangiust, V.; Terrani, M.; Terrani, S. (Politecnico, Milan). Energ. Nucl. (Milan); 20: No. 2, 111-113(Feb 1973).

The yields of the first and second delayed neutron groups in the neutron fission of ^{237}Np and ^{241}Am were determined by comparison with ^{232}Th and ^{238}U. The measurement is described and discussed. (auth)

21171 STUDY OF THE ^{225}Ac LEVEL SCHEME. Aguer, P.; Peghaire, A.; Liang, C. F. (Centre de Spectrometrie Nucleaire et de Spectrometrie de Mass, Ursay, France). Nucl. Phys.; A202: No. 1, 37-48(1973). (In French).

The ^{225}Ac level scheme, populated by the α branching (0.25%) of ^{229}Pa, was investigated with an α spectrograph and a two-dimensional $\alpha-\gamma$ coincidence device. The proposed level scheme was interpreted in terms of rotational bands, and attempts to describe it in terms of the Nilsson configurations $3/2^+[651]$, $5/2^+[642]$, $3/2^-[532]$, and $5/2^-[523]$ were made. The perturbation of the $K = 3/2$ bands due to the Coriolis coupling was also discussed. (auth)

21172 RECOIL RANGES AND KINETIC ENERGY DISTRIBUTION IN THE REACTOR NEUTRON INDUCED FISSION OF ^{241}Am. Prakash, S.; Manohar, S. B.; Dange, S. P.; Ramaswami, A.; Ramaniah, M. V. (Bhabha Atomic Research Centre, Bombay). Radiochim. Acta; 18: No. 1, 35-38(Dec 1972).

Recoil ranges in aluminum were determined for seventeen fission products from reactor-neutron-induced-fission of ^{241}Am. From the recoil range data, the kinetic energy distribution as a function of fragment mass was obtained; three different range–energy equations were used. It was found that both in magnitude and shape the kinetic energy distribution is dependent on the range–energy equations. By using the kinetic energy data obtained in the present work, deformation of fission fragments was calculated. (3 figures, 3 tables) (auth)

21173 EXCITATION OF 0^+-STATES IN TWO-NUCLEON TRANSFER REACTIONS. Abdulvagabova, S. K.; Ivanova, S. P.; Pyatov, N. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 6, 1209-1217(1972). (In Russian).

Spectroscopic factors for excitation of 0^+-states in deformed nuclei have been studied in two-nucleon transfer reactions. It is shown that qualitative explanation for observable regularities in relative cross-sections for excitations in (p,t) reaction can be obtained in the model with pair and quadrupole forces. Account for spin-quadrupole interaction is necessary but not sufficient for quantitative agreement with empirical data. (auth)

21174 FISSIONING ISOMER ^{237m}Np. Wolf, K. L.; Unik, J. P. (Argonne National Lab., IL). Phys. Lett.; 43B: No. 1, 25-26(8 Jan 1973).

A spontaneously fissioning isomer of ^{237}Np with a half-life of 40 ± 12 ns was discovered. Threshold measurements indicate that the isomer excitation energy is 2.7 ± 0.3 MeV. It is concluded that the spontaneous fission is not the principal decay mode for this shape isomer. (auth)

21175 PRODUCTION AND NATURAL OCCURRENCE OF THE TRANSURANIUM ELEMENTS. Keller, C. (Univ., Karlsruhe, Ger.). Ind. At. Spatiales; 16: No. 5, 19-37(Sep 1972). (French and English).

Transuranic elements do not occur in nature, with the exception of minute traces of the long-half-life isotope ^{244}Pu. Different types of nuclear reactions are used to synthesize these elements: neutron irradiation in a nuclear reactor, thermonuclear explosions, and the bombardment of suitable target nuclei with heavy ions. The advantages and disadvantages of the various processes, their yields and identification of single atoms of short lived heavy element isotopes up to hahnium (nielsbohrium) are discussed together with current methods suggested for synthesizing elements near to the doubly magic proton numbers Z = 114 and Z = 164. (FR)

Nuclear Theory

Refer also to abstracts 20937, 20958, 21007, 21059, 21089, 21101, 21128, 21145, and 21152.

21176 (COO–1764-146) DISTORTED-WAVE THEORY FOR TWO NUCLEON TRANSFER. Bayman, B. F. (Minnesota Univ., Minneapolis. School of Physics and Astronomy). 1973. 16p. Dep. NTIS.

The philosophy behind computer programs for calculating one- and two-nucleon-transfer reactions is discussed first. In the latter case a severe approximation for the product of the interaction and heavy-projectile wave function is made. Attempts to evaluate two-neutron-transfer DWBA integrals exactly are then described. The Monte Carlo method was found to be much faster than Gaussian integration on each variable in the appropriate six-dimensional integrals. The results are compared with data from the ^{40}Ca(t,p) reaction at 10.1 MeV. The finite-range angular distributions and relative cross sections agree with those given by the zero-range calculation, but the absolute cross section is too small to fit the data. Two-step processes may be significant, and the finite-range DWBA calculation is dominated by the transfer of a neutron pair in a relative s state. (4 figures) (RWR)

21177 (COO-3001-30) SELF-SCREENING OF THE PARTICLE–HOLE INTERACTION AND THE EFFECTIVE CHARGE. Kuo, T. T. S.; Osnes, E. (State Univ. of New York, Stony Brook. Dept. of Physics). 1972. Contract AT(11-1)3001. 27p. Dep. NTIS.

The diagrams of the Tamm–Dancoff and random-phase approximations were summed to calculate the effective charge in the (1s0d) and (1p0f) shells. The generally large RPA result for the effective charge is reduced to roughly the TDA one when the self-screening corrections to the particle–hole and ground-state correlation vertices are included. The screening corrections serve to suppress the collectivity of the isoscalar quadrupole core phonons, and are particularly important for ^{40}Ca, where the isoscalar quadrupole mode is near collapse in the RPA using the bare particle–hole interaction. The qualitative rather than the quantitative effects of these and other corrections are stressed. (5 figures, 7 tables) (auth)

21178 (COO-3001-32) EFFECTIVE NUCLEAR MAGNETIC MOMENTS. Arima, A. (State Univ. of New York, Stony Brook. Dept. of Physics). 1972. Contract AT(11-1)3001. 31p. Dep. NTIS.

Two mechanisms to modify the nuclear magnetic dipole operator

are discussed. They are the effects of core polarization and mesonic exchange current. The former contributes mainly to δg_s; while the latter, to δg_l. (6 tables) (auth)

21179 (DEMO-72/13) KINEMATICS OF THREE-BODY REACTIONS. Assimakopoulos, P. A. (Democritus Nuclear Research Center, Athens (Greece)). Oct 1972. 42p. Dep. NTIS (U. S. Sales Only).

The kinematics of three-body reactions is reviewed, and the most frequently encountered expressions for final-state-interaction and angular-distribution analysis are presented in a form convenient for computer programming. For simplicity only coplanar events are considered. Two FORTRAN codes for the employment of these expressions and the graphic representation of the kinematic locus are given. (auth)

21180 FRONTIERS OF NUCLEAR PHYSICS. Frahn, W. E. (Univ. of Cape Town). pp 1-16 of Fifth Annual Seminar on Theoretical Physics. Pretoria; Atomic Energy Board (1970).

From 5th annual seminar on theoretical physics; Pretoria, South Africa (13 Jul 1970). See CONF-700728.

Research in nuclear physics aimed at the discovery of new phenomena and relationships is reviewed. Developments concerning the quantum numbers of space, time, momentum, energy, angular momentum, parity, baryon number, electric charge, isospin, and hypercharge are discussed. (JWR)

21181 MANY-BODY PROBLEM WITH APPLICATION TO THE MICROSCOPIC DESCRIPTION OF ISOSPIN IN NUCLEI. Engelbrecht, C. A. (Atoomkragraad, Pelindaba, S. Afr.). pp B.1-100 of Fifth Annual Seminar on Theoretical Physics. Pretoria; Atomic Energy Board (1970). (In Afrikaans).

From 5th annual seminar on theoretical physics; Pretoria, South Africa (13 Jul 1970). See CONF-700728.

The paper begins by discussing the random phase approximation; Fermi gas and Fermi liquid; and the operator formalism, equations of motion, and density matrix. The equations of motion are then considered in more detail; the Hartree-Fock basis, ground-state correlations in the RPA, and symmetry breaking are treated. The discussion of Green's functions begins with a general overview of the single-particle Green's function, and then proceeds to the Goldstone expansion and Feynman diagrams, and polarization and two-particle Green's functions. The final part, on isospin polarization, encompasses the single-particle description of isospin; Hartree-Fock and isospin polarization; and Green's functions, renormalization, and Lane equations. (RWR)

21182 MICROSCOPIC NUCLEAR SCATTERING THEORIES-PARTICLE-HOLE SYSTEMS. Hahne, F. J. W. (National Physical Research Lab., Pretoria). pp C.1-18 of Fifth Annual Seminar on Theoretical Physics. Pretoria; Atomic Energy Board (1970).

From 5th annual seminar on theoretical physics; Pretoria, South Africa (13 Jul 1970). See CONF-700728.

Nucleon scattering on nuclei lacking one nucleon from having both shells closed is considered. A brief outline of the derivation of the reaction theory in random phase approximation and Tamm-Dancoff approximation is given. The analytic properties of the S-matrix are discussed. Extensions of the formalism to include 2p-2h configurations are briefly sketched. (JWR)

21183 MODEL FOR THE SYMMETRY POTENTIAL. Viljoen, J. du P.; Lemmer, R. H. pp D.1-17 of Fifth Annual Seminar on Theoretical Physics. Pretoria; Atomic Energy Board (1970). (In Afrikaans).

From 5th annual seminar on theoretical physics; Pretoria, South Africa (13 Jul 1970). See CONF-700728.

The description of the problem begins with a definition of the symmetry potential and enumeration of the basic assumptions; the model is then developed. Calculations were done for ^{48}Ca, ^{88}Sr, and ^{208}Pb. Results are presented and discussed for the symmetry potential and the neutron and proton potentials; the symmetry energy and oscillator potential are also addressed. Finally, an equation for calculating the symmetry potential with empirical formulas for the symmetry effects is given. (7 figures) (RWR)

21184 OFF-SHELL AND HIGH ENERGY ON-SHELL DEPENDENCE OF THE TRITON BINDING ENERGY. Fiedeldey, H. pp E.1-33 of Fifth Annual Seminar on Theoretical Physics. Pretoria; Atomic Energy Board (1970).

From 5th annual seminar on theoretical physics; Pretoria, South Africa (13 Jul 1970). See CONF-700728.

The use of the three-nucleon problem for studying the nuclear force is discussed. The use of various potentials in the calculation of the triton binding energy is examined. The inclusion of off-shell and high energy on-shell effects in these calculations is described. (JWR)

21185 GROUP THEORETICAL APPROACH TO THE MANY NUCLEON PROBLEM. De Wet, J. A. pp F.1-21 of Fifth Annual Seminar on Theoretical Physics. Pretoria; Atomic Energy Board (1970).

From 5th annual seminar on theoretical physics; Pretoria, South Africa (13 Jul 1970). See CONF-700728.

Representations of the four-dimensional unitary group U_4 were considered by Wigner (1937) as a model for nuclear isobaric multiplets. However, the Hamiltonian did not include the components of isospin which together with the spin coordinates are known to label the nuclear states. Representations characterized by the eigenvalues of angular momentum, isospin, and parity are found along with mass relations which give good agreement with the experimental energy levels of Li and its isotopes labelled by the same quantum numbers. The representations found by Wigner give good results for the ground state energies or masses of all the nuclei up to A = 110. Wigner's representations are derived as a special case. (WDM)

21186 PROMPT FISSION NEUTRON SPECTRA. Kluge, G. (Central Research Inst. for Physics, Budapest). pp 149-160 of Prompt Fission Neutron Spectra. Vienna; International Atomic Energy Agency (1972).

From Proceedings of a Consultants' Meeting on Prompt Fission Neutron Spectra; Vienna, Austria (25 Aug 1971). See STI-PUB-329; CONF-710845-.

Some of the main features of the present theoretical understanding of the fission neutron spectra are discussed. The effect of a possible center-of-mass anisotropy and the validity of Terrell's $T(\bar{\nu})$ relation are discussed. Results of some calculations on the prompt fission neutron spectra are given. (5 figures, 1 table) (auth)

21187 REMARKS ON NEUTRON FISSION RELATED TO THE RELATIVE IMPORTANCE OF THE SYMMETRIC AND ASYMMETRIC FISSION MODES. De Leeuw-Gierts, G.; De Leeuw, S. (CEN, Mol, Belg.). pp 161-167 of Prompt Fission Neutron Spectra. Vienna; International Atomic Energy Agency (1972).

From Proceedings of a Consultants' Meeting on Prompt Fission Neutron Spectra; Vienna, Austria (25 Aug 1971). See STI-PUB-329; CONF-710845-.

Any comparison between experimental mean energies of neutron-induced fission spectra and theory up to now were performed without taking into account the existence of the two different fission modes: a symmetric and an asymmetric one. It is shown that the discrepancy observed with Terrell's laws could reasonably be explained if the physical characteristics of the neutrons emitted during symmetric and asymmetric fission were not the same; i.e., if neutrons emitted during symmetric fission were not emitted by the fully accelerated fission fragments but at the moment of scission with the spectral characteristics found for the scission neutrons of thermal fission. (3 figures) (auth)

21188 RELATIVITY AND SPIN-ORBIT INTERACTION IN NUCLEI. Krutov, V. A.; Savushkin, L. N. (Leningrad State Univ.). J. Phys., A (London); 6: No. 1, 93-105 (Jan 1973).

It is shown that the observed spin-orbit splittings in the atomic nuclei may be explained theoretically if one takes into account the relativistic character of the nucleon motion in the bound many-nucleon system. The relativistic corrections were obtained from the approximately relativistically invariant (to within terms in v^2/c^2) Breit-type equation for two nucleons. Two-particle interactions were taken in the form of one-boson-exchange potentials which reproduce well the nucleon-nucleon scattering data and which include pseudoscalar, scalar and vector mesons and resonances. The calculations of the doublet splittings of different single-particle levels in ^{41}Ca and ^{209}Pb were carried out, the values of the nuclear average field being calculated as well. Agreement with experiment is reasonably satisfactory. (auth)

21189 DIRECT NUMERICAL INTEGRATION OF COUPLED ONE DIMENSIONAL SCHROEDINGER EQUATIONS. Beiner, M.; Gara, P. (Institut de Physique Nucleaire, Orsay, France). Comput. Phys. Commun.; 4: No. 1, 1-9 (Oct 1972).

Physical problems which can usually be described with the help of sets of coupled second-order differential equations are outlined. In the case of scattering problems, the direct numerical integration of these equations is the unique method of obtaining a solution. For bound-state calculations this integration is in direct competition with powerful conventional techniques such as the variational principle and the standard matrix diagonalization. Two methods for solving by direct integration the eigenvalue problem associated with sets of coupled one-dimensional Schroedinger equations are developed. These methods are successfully used to calculate the bound states of nuclear three- and four-body systems with two-body pure central forces. (auth)

21190 NUCLEAR PHYSICS EQUATION MODEL. One Channel of Decay. Baz, A. I.; Zhukov, M. V. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 16: No. 5, 958-973 (1972). (In Russian).

Proceeding from the equations obtained previously (Yadern. Fiz.; 16, 60(1972)), there is studied a system of A nucleons with one binary decay channel. It is shown that account for the decay channel leads to distortions of the spectrum for nucleus levels and to particular states of "quasimolecular" type, appearing in its spectrum. Simple formulae were obtained for an effective potential of interaction between two nuclei. The problem of cluster elastic scattering with account for the connection of this channel with the nucleus internal area was also considered. (auth)

21191 IZOSPIN V YADERNOI FIZIKE. (Isospin in Nuclear Physics). Naumov, Yu. V.; Kraft, O. E. Svoistva Atomnykh Yader, Vypusk 14. Leningrad; Izdatel'stvo Nauka Leningradskoe Otdelenie (1972). 184p.

The role of isobaric spin in physics and the isospin selection rules in β decay, γ transitions, and nuclear reactions are discussed. The excitation of analog states in various nuclear reactions and the structure of the nucleus as derived from analog state experiments are considered. The excitation of analog resonances in elastic proton scattering and the energies involved, pertinent spectroscopic investigations, and the gamma decay of analog resonances are explored. (Over 300 references) (KSW)

21192 INTERNAL CONVERSION COEFFICIENTS FOR M_{IV-V} SUBSHELLS OF THE ATOM Z = 68. Shulyakovskii, G. S.; Trusov, V. F. (Belorussian State Univ., Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 1, 129-32(1972). (In Russian).

Numerical values of internal conversion coefficients were given for the atom Z = 68 for the first five multipole orders and for a series of energy transition values. The finite dimensions of the nucleus were accounted for. Allowance was made for shielding by Gaspar's potential in a modification for an ion with semi-empirical corrections. An approximate evaluation of the influence of the finite dimensions of the nucleus was made at the calculated internal conversion coefficients. (tr-auth)

21193 GROUP THEORY APPLICATIONS TO NUCLEAR SPECTROSCOPY. Szpikowski, Stanislaw (Inst. of Physics, Lublin). Postepy Fiz.; 23: No. 5, 541-60(1972). (In Polish).

The review of the traditional group theory applications to nuclear spectroscopy is given in a way that can be applied to the recent advances of the subject. (auth)

21194 SPONTANEOUSLY FISSIONING ISOMERS. Jastrzebski, Jerzy (Inst. of Nuclear Research, Swierk, Poland). Postepy Fiz.; 23: No. 5, 561-81(1972). (In Polish).

Available experimental informations concerning the production, half-lives, and excitation energies of spontaneously fissioning isomers are reviewed. Some comparisons with the theoretical predictions are presented. (auth)

21195 STUDY OF THE P-WAVE NEUTRON STRENGTH FUNCTIONS. Chaubey, A. K.; Sehgal, M. L. (Aligarh Muslim Univ., India). Indian J. Phys.; 46: No. 3, 114-18(Mar 1972).

S-wave neutron capture cross sections were calculated at 24 keV using low-energy resonance parameters. These values were then subtracted from earlier experimentally measured values of the capture cross sections. P-wave capture cross sections were thus estimated in a large number of cases. P-wave neutron strength function (Γ_n^1/D) was calculated using these estimated values of P-wave cross sections. Some interesting results were obtained. (auth)

21196 ROTATIONAL-SINGLE PARTICLE STATES OF ATOMIC NUCLEI. Salakhitdinov, A. N.; Sharipov, Sh. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 4, 31-3(1971). (In Russian).

The succession of spins from $^1/_2$ to $^{21}/_2$ and the ratio of their energies were studied for odd nuclei, allowing for a connection between rotational motion and single-particle states. Theoretical and experimental spin values and energy levels were compared for the odd nucleus ^{165}Ho, and good agreement was noted. (KSW)

21197 AMOUNT OF MULTIPLE SCATTERING IN THE ENERGY SPECTRUM OF INELASTICALLY SCATTERED FAST NEUTRONS. Katase, Akira; Akiyoshi, Tsunekazu; Sonoda, Masateru (Kyushu Univ., Fukuoka). Kyushu Daigaku Kogaku Shuho; 45: No. 3, 324-331(Jun 1972). (In Japanese).

Multiple scattering of fast neutrons was investigated. The inelastic scattering cross section of neutrons having energy of E_0 is given according to the compound nuclear reaction theory. It was necessary, for the measurement of angular distributions of the inelastically scattered neutrons, to consider dual scattering, that is, inelastic scattering after elastic scattering, elastic scattering after inelastic scattering, and double inelastic scattering. The probability of the dual scattering was compared with the probability of single inelastic scattering. The probability of triple scattering, one inelastic and two elastic scattering being the most important, was also calculated. Contributions of (n,2n) reactions were taken into account. Practical calculations were carried out for the 14-MeV neutrons scattered by a ^{209}Bi scatterer. Errors due to approximations are discussed. (Kato)

21198 ISOSPIN COUPLING POTENTIAL BELOW THE QUASI-ELASTIC (p,n) THRESHOLDS. Ramavataram, S. (Laval Univ., Quebec). Can. J. Phys.; 50: No. 20, 2482-8 (15 Oct 1972).

A form for the isospin coupling potential is derived using a particle–hole model and a coupled-channel treatment of the isobaric analog resonance. It is well suited for numerical investigations. Comparison with the phenomenological approach shows that the treatment provides interesting insights into the real and imaginary components of this potential. (auth)

21199 SPIN DEPENDENCE IN THE DEUTERON OPTICAL MODEL. Haeberli, W. (Univ. of Wisconsin, Madison). Rev. Brasil. Fis.; 2: No. 1, 187-211(1972). (COO-7-617).

The presence of a spin–orbit term in the deuteron optical model is revealed from measurements of the vector analyzing power on many nuclei. A spin-orbit force of the Thomas form and geometrical parameters about 20% smaller than those of the central potential gives an adequate description of the results. The spin–orbit strength is compatible with the Watanabe model, but there are indications that agreement with the measurements can be obtained over a considerable range of values if all other parameters are readjusted. Accurate measurements of the total reaction cross section would be helpful. Measurements of the tensor analyzing powers show that some form of tensor interaction is required. The effect of the tensor force is also seen in d-α scattering. From observations on Mg, Si, Al, and Ca there is some evidence that the $S \cdot r$ tensor potential may be the most important one. The fact that two of the three forms of tensor interaction do not conserve l introduces a substantial complication in the calculations. The non-diagonal elements have been neglected in most calculations but this approximation must be studied further. The tensor effects caused by the quadrupole moment of the deuteron are found to be small. The possibility to study the deuteron spin dependence from polarization measurements on l = 0 stripping transitions has not yet been fully explored. Measurements are needed of the vector and tensor analyzing powers for (d,p) and the inverse (p,d) reaction at the same center-of-mass energy. Recent measurements of the T_{21} analyzing power in stripping reactions suggest that this term is particularly sensitive to the deuteron tensor interaction. (auth)

21200 APPROXIMATE TREATMENTS OF COLLISION INTEGRALS FOR (n,n') INELASTIC SCATTERING AND (n,2n) REACTIONS. Yamamura, Y.; Yamamoto, K.; Kitazoe, Y.; Sekiya, T. (Osaka Univ., Suita, Japan). Technol. Rep. Osaka Univ.; 21: 371-83(Oct 1971).

Approximate treatments of (n,n') inelastic scattering and (n,2n) reactions of fast neutron are discussed under the following assumptions: (a) The fast neutron is inelastically scattered from a nucleus at rest, leaving this nucleus in a specified excited state; (b) The entire analysis is independent of the reaction mechanisms and only depends on the reaction kinematics; and (c) The (n,2n) reaction can be treated by the cluster model. The synthetic kernel for the (n,n') inelastic scattering enables one to treat its collision integral by a simple recursion relation, which may allow rapid computation of the inelastic collision integral. (auth)

21201 AVERAGE NEUTRON CROSS SECTIONS IN THE UNRESOLVED RESONANCE RANGE. Beer, Mendel (Mathematics Applications Group, Inc., Elmsford, NY). Nucl. Sci. Eng.; 50: No. 2, 171-173(Feb 1973).

A method is presented for calculating neutron cross sections averaged over the partial width fluctuations in the unresolved resonance range. The N dimensional integral ($N \leq 4$) which appears in the averaging procedure is mathematically reduced to integration in a single dimension. The resultant expression is numerically evaluated by a Gaussian quadrature technique. (auth)

21202 SHELL MODEL AND QUASI-PARTICLE CALCULATIONS OF THE NEUTRON DEFICIENT LEAD ISOTOPES. Harvey, T. F. Davis, CA; Univ. of California (1972). 152p. University Microfilms Order No. 72-24,599.

Thesis.

A number of model calculations of the lead isotopes with A < 208 are performed using an effective interaction of the bare Tabakin reaction matrix plus a pairing term to simulate core polarization: (1) standard shell model calculations of ^{206}Pb and ^{205}Pb where the model space includes the six filling neutron orbitals below N = 126; (2) quasi-particle configuration-mixing calculations where the excited states of the even isotopes are treated in a two-quasi-particle basis, the odd isotopes in a one-quasi-particle, three-quasi-parti-

cle basis. The input to the latter calculations are the quasi-particle energies obtained from the (i) conventional BCS, (ii) the IGE and (iii) the improved IGE procedures. Spectroscopic factors for one-nucleon-transfer reactions are reported. It is concluded that the IGE model is particularly applicable in the lead region. (Diss. Abstr. Int., B)

21203 PION–NUCLEUS INELASTIC SCATTERING IN THE DISTORTED-WAVE BORN APPROXIMATION. Edwards, G. W. Boulder, Colo.; Univ. of Colorado (1972). 152p. University Microfilms Order No. 72-25,160.

Thesis.

The inelastic scattering of pions from nuclei is described in the framework of the nuclear collective model. In the region of the 3,3 pion-nucleon resonance (pion kinetic energies of 100 MeV to 300 MeV), elastic pion-nucleus scattering is represented by an optical potential first introduced by Kisslinger, in which the p-wave character of the pion-nucleon interaction appears in the form of gradient operators in configuration space. The optical model parameters are completely determined from pion-nucleon scattering phase shifts. By deforming the spherically symmetric nucleon density distribution which appears in the optical potential, non-spherical terms are obtained which connect the nuclear ground state to excited rotational states of the nucleus. The inelastic differential cross section is then calculated in the distorted-wave Born approximation. The results of the calculation compare favorably with existing (π,π') data for the ^{12}C nucleus in the energy region 120 to 280 MeV. The first inelastic diffraction peak is described quite well; at wider angles, the prediction is only qualitatively correct. The necessity of including a p-wave term in the optical potential is clearly demonstrated, since inelastic cross sections calculated using a pure s-wave pion-nucleon interaction are inadequate except at very forward angles. In general, the inelastic scattering formalism is successful in the same energy and momentum-transfer regions in which the optical potential gives a good description of the elastic scattering. The successful fitting of the first diffraction peak permits an accurate determination of deformation parameters for the excited states. For the 2^+ (4.44 MeV) and 3^- (9.64 MeV) levels in ^{12}C, the values $\beta_2 = 0.57 \pm 0.04$ and $\beta_3 = 0.51 \pm 0.01$ are obtained. Inelastic differential cross sections at incident pion kinetic energies of 100, 200, and 300 MeV are also calculated for excited states in ^{24}Mg, ^{40}Ca, ^{58}Ni, ^{120}Sn, and ^{208}Pb. All of these cross sections display the strong diffraction structure characteristic of a strongly absorbed projectile. The position of the first diffraction peak moves outward in angle with increasing angular momentum transfer, and the peak cross section increases with both energy and nuclear size. The Blair phase rules, in which the elastic and odd parity inelastic cross sections are in phase with each other and out of phase with the even parity inelastic cross sections, are obeyed. The DWBA formalism is also applied to the ingle charge exchange reaction (π^+,π^0). For the reaction $^{91}Zr(\pi^+,)^{91}Nb^*$, the total cross section displays a broad minimum at 30 MeV, with a value of 35 μb at the minimum and 145 μb at 00 MeV. The minimum in the cross section is shown to be a esonance phenomenon, but its location at an energy well below the resonance is not explained. A differential cross section for the $^{91}Zr(\pi^+,\pi^0)$ reaction at 80 MeV is also presented. (Diss. Abstr. Int., B)

21204 NEW PROPOSALS IN THE CLASSIFICATION OF STATES IN THE NUCLEAR SHELL MODEL. Szpikowski, S. (Inst. of Physics, Lublin). Postepy Fiz.; 23: No. 6,613-631 (1972). (In Polish).

The quasi-spin and quasi-particle methods in the classification problem in the nuclear shell model are described. In particular, the new possibilities and improvements of the methods as compared to the traditional classification are discussed. Several examples underline formal as well as physical advantages of the new approach and its applications to the classification problem. (2 tables) (auth)

21205 DIFFRACTION SCATTERING OF 1p-SHELL NUCLEI. Ismatov, E. I. (Inst. of Nuclear Physics, Kiev). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 5, 53-56(1972). (In Russian).

The theoretical aspects of the inelastic diffraction reaction of 1p-shell nuclei with other nuclei were investigated. Equations were developed with which an analysis was made of the inelastic scattering and reactions with mutual excitation of the nuclei ^{12}C and ^{16}O at energies of 72 MeV in the cms. (KSW)

21206 EFFECTS OF NUCLEON PAIRING IN THE COMPOUND NUCLEI ^{238}Pu AND ^{243}Pu. Fomushkin, E. F.; Gutnikova, E. K. Dokl. Akad. Nauk SSSR; 206: No. 5, 1088-1089(11 Oct 1972). (In Russian).

This paper represents an extension of previous work by the same authors (1969) on the angular distribution of fragments of nuclear fission of ^{238}Pu and ^{242}Pu by 0.45- to 3.6-MeV neutrons. The gradual change in the function $K_0^2(E^*)$ (where K_0^2 is the projection dispersion of angular momentum on the symmetry axis of the nucleus and E^* is related to the energy of the fission threshold) was explained by the effect of pair correlations on the spectrum of internal excitations of the nucleus at the saddle point. It was shown that the change in the angular distribution of fission fragments near the threshold facilitates the study of the double-humped fission barrier. (KSW)

21207 STUDY OF ISOBARIC ANALOG RESONANCES. Popescu, D.; Lazar, Ioana (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 24: No. 9, 1139-1177(1972). (In Rumanian).

This review covers Coulomb energy shifts, width calculations, fine structure of isobaric analogs, isobaric analog resonances as intermediate structure, and spectroscopic information from isobaric analog resonances. (LTW)

21208 COUPLED-CHANNEL APPROACH TO THE ISOMER FISSION STATE. Hooshyar, M. A. (Univ. of Maryland, College Park); Malik, F. B. Helv. Phys. Acta; 45: 567-79(1972).

It has been shown that the isomer fission states can originate from the simple channel coupling phenomenon. The set of coupled channel equations of the recently proposed theory of fission is treated in two approximations: (i) a simple two coupled channel case and (ii) a coupled system of N channels. In each case, under a certain physical assumption, it has been possible to find a transformation which uncouples the N channels. In the two channel case, the longer and the shorter half-lives can, respectively, be identified with the spontaneous and the isomer fission states. The N channel case reduces effectively to only 3 uncoupled equations. One of these corresponds to the scattering process for the parameters pertinent to the fission case. Thus, the N channel case reduces effectively to two independent decay channels. The half-lives associated with these two decay channels can again be identified with the decay of the spontaneous and isomer fission states. This treatment of the multichannel decay process is equally valid for the Bohr-Wheeler type of theory and can also be applied to uncouple the scattering problem, which fulfills the basic assumption of this model. (auth)

21209 DERIVATION OF THE g(ν) FUNCTION FROM DATA ON INELASTIC COHERENT SCATTERING OF SLOW NEUTRONS. Gorbachev, B. I.; Ivanitskii, P. G.; Krotenko, V. T. (Inst. of Nuclear Research, Kiev). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 5, 789-95(May 1972). (In Russian).

It is shown that the phonon frequency distribution function g(ν) determined by models, which describe well the experimental dispersion curves $\nu_s(\vec{q})$ in the symmetrical directions of the reciprocal lattice is now determined with precision not more than ~10 to 15%. The method is proposed to analyze one-phonon coherent scattering cross sections of slow neutrons, which allows one in principle to obtain the g(ν) function with the precision to some per cent. (auth)

21210 MEASURING POLARIZATION CORRELATION IN NUCLEAR REACTIONS. Vysotskii, G. L.; Chegoryan, M. A. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 5, 746-9(May 1972). (In Russian).

Experimental possibilities are considered for measuring polarization correlation in the model of direct nuclear reactions and in case of threshold reactions with the knocking-out of the final particle in the s-state. (auth)

21211 STRUCTURE OF ^6Li FROM HIGH-ENERGY PROTON SCATTERING. Raphael, R. B. (Emory Univ., Atlanta). Nucl. Phys.; A201: No. 3, 621-640(1973).

The elastic and inelastic (2.189-MeV level) scattering of 1-GeV protons from ^6Li is predicted using Glauber multiple-scattering theory in conjunction with an α-d cluster model capable of fitting quantitatively a large number of measured form factors, in particular the most recent high-momentum-transfer electron scattering data. The predictions, especially in the inelastic channel, are quite sensitive to the parameters of the model. A valuable opportunity is thus provided via experiments well within the capabilities of LAMPF for comparison of structure information obtained from proton scattering with that from other sources in the case of a "test" nucleus whose properties are relatively well determined and unambiguous. Moreover, proton scattering goes beyond electron scattering in possibly providing information about the effective real part of the proton-deuteron cluster amplitude, and thus indirectly about D-state effects in the deuteron cluster. (auth)

21212 NUCLEAR STABILITY AND THE SUPER-HEAVY ELEMENTS. Cuninghame, J. G. (Atomic Energy Research Establishment, Harwell, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 1, 21-26(Jan 1973).

The reasons for the stability of certain nuclei are explained,

and the main types of decay in radioactive nuclei, i.e., β decay, α decay and spontaneous fission, are discussed. It is shown that theoretically there should be a region of the periodic table where nuclei again become reasonably stable, and possible ways of producing and identifying these super-heavy elements are discussed. Reference is made to some experiments on natural sources and artificial production of super-heavy elements. (UK)

21213 RADIOACTIVE DECAYS. Goldanskii, V. I. (Inst. of Physical Chemistry, Moscow). Recherche (Paris); 3: No. 28, 949-957(Nov 1972). (In French).

The various modes of radioactive disintegration are reviewed, and the various types of particles able to be ejected are presented (α emission, β decay, spontaneous and isomeric fission, β decay followed by an emission of α particles, and delayed neutrons and protons, proton and diproton emission). (France)

21214 SINGLE-PARTICLE STATES OF HEAVY AND SUPER-HEAVY NUCLEI IN A VELOCITY-DEPENDENT POTENTIAL. Lodhi, M. A. K. (Texas Tech Univ., Lubbock). Z. Naturforsch.; 27a: No. 12, 2p(Dec 1972).

Single-particle energy calculations were performed for some closed-shell heavy and superheavy nuclei using a form of an effective velocity-dependent nucleon-nucleus potential. Results are compared with other calculations and experimental data wherever available. (auth)

21215 SOME PROPERTIES OF THE MOSHINSKY COEFFICIENTS. Efros, V. D. Atomic Energy Inst., Moscow). Nucl. Phys.; A202: No. 1, 180-190(1973).

Moshinsky has suggested a method of calculating Talmi transformation coefficients in which the coefficients with two radial quantum numbers equal to zero are calculated first and then recursion formulas over radial quantum numbers are applied. The coefficients with two radial quantum numbers equal to zero are shown to be expressed as factorials, in terms of a particular type of coefficient with all radial quantum numbers equal to zero, and a simple formula for these coefficients is given. Some interesting properties of the Moshinsky coefficient sums are found, and a simple formula expressing the coefficients of the "three-body" hyperspherical function transformation in terms of generalized Moshinsky coefficients is obtained. Recursion formulas and symmetry relations for the Moshinsky coefficients are also discussed. (auth)

21216 PERIPHERAL-MODEL APPROACH TO STRIPPING INTO RESONANT STATES. Dolinsky, E. I. (Moscow State Univ); Dzhamalov, P. O.; Mukhamedzhanov, A. M. Nucl. Phys.; 202: No. 1, 97-122(1973).

A simple model is proposed for the description of stripping to a resonant state. This model is based on the peripheral model of binary direct reactions, which was developed recently within the framework of the dispersion theory of direct interactions. It is shown that the information on the orbital angular momentum, l_n, the spin, J, and the neutron width, Γ_n, of the resonant level can be obtained from the comparison of the theoretical differential cross sections calculated in terms of the proposed model with experimental ones. (9 figures, 3 tables, 65 references) (auth)

21217 NEW PARTICLE-HOLE APPROACH TO COLLECTIVE STATES. Bouten, M. (SCK-CEN, Mol, Belgium); Van Leuven, P.; Mihailovic, M. V.; Rosina, M. Nucl. Phys.; A202: No. 1, 127-144(1973).

The relevance of the particle-hole space is demonstrated by showing that in some commonly used formalisms the first excited state lies entirely within the particle-hole space generated from the correlated ground state. This property is proved for several cases of angular-momentum projection—projected Hartree-Fock method (PHF)—and for the generator-coordinate method in the Gaussian overlap approximation, while in other cases it is verified only numerically. A new method is presented for the approximate calculation of energies and transition amplitudes of particle-hole excited states. Only hermitian one-body operators are used to generate the excited states. The two-body density matrix of a correlated state approximating the ground state is required as input data. The formula is tested on the 2^+ and 3^- states of ^{8}Be and ^{12}C by using the PHF ground state. Where comparison is possible, the method gives better agreement with PHF and experiment than the extended random-phase approximation. (3 tables) (auth)

21218 REFLECTION OF ON-SHELL BEHAVIOR ON THE OFF-SHELL REACTION MATRIX ELEMENTS. Srivastava, M. K. (Univ. of Roorkee, India). Nucl. Phys.; A202: No. 6, 145-151 (1973).

The effect of varying the on-shell reaction matrix elements (phase shifts) on the half-off-shell reaction matrix elements was investigated by using second-rank separable potentials. It was found that $K(p, k; k^2)$ is determined primarily by the on-shell data up to p or k, whichever is larger. The influence of the on-shell data beyond this, although dependent on the nature of the interaction, was found to be very little. (11 figures) (auth)

21219 GENERALIZED QUARTET MODEL FOR PARTICLE-HOLE EXCITATIONS ACROSS MAJOR SHELLS. Harvey, M. (Chalk River Nuclear Labs., Ont.). Nucl. Phys.; A202: No. 1, 191-208(1973).

The schematic quartet model of Arima, et al., is generalized to include any number of particle-hole excitations. The assumption of constancy of particle-hole matrix elements with mass number is examined in the deformed-oscillator model and shown to be poor in certain cases. A revised picture for particle-hole excitations shows smoother trends than with the schematic model. Comparison with the Zamick model yields greater insight into the structure of two-particle excited states. (6 figures, 3 tables) (auth)

21220 SINGLE AND DOUBLE PROJECTIONS OF GENERATOR-COORDINATE WAVE FUNCTIONS. Wong, C. W. (Massachusetts Inst. of Tech., Cambridge). Nucl. Phys.; A202: No. 1, 209-224(1973).

By re-examining single- and double-projection methods for translation and rotation it is found that both the Peierls-Yoccoz single projection and the Peierls-Thouless double projection of angular momentum may contain similar errors due to the inclusion of the spurious cm degrees of freedom. These errors are estimated by using a simple product of deformed Gaussian single-particle wave functions. Large errors appear even in heavy nuclei when the cm kinetic energy is included in the Hamiltonian. Other spurious effects studied have a rough A^{-1} behavior. The conjugate generator coordinate in the Peierls-Thouless method is found to have no effect on angular-momentum projections. It serves a configuration-mixing role. The configurations so mixed appear to be determined partly by the choice of basis for the single-particle wave functions and partly by the nature of the first projection. (2 tables) (auth)

21221 TWO-BODY FORCE IN NUCLEI. Proceedings of the Symposium Held at Ann Arbor, Michigan, September 7-10, 1971. Austin, S. M.; Crawley, G. M. (eds.). New York; Plenum Publishing Corporation (1972). 401p. $25.00 (CONF-710915).

Separate abstracts were prepared for 22 of the papers contained in this volume. The remaining two have already appeared in NSA as abstracts 25: 59241 and 26: 3644. (RWR)

For abstracts of individual papers see: 20867, 21055, 21075, 21100, 21101, 21126, 21145, 21229, and 21230-21243.

21222 HIGH-ENERGY MULTIPLICITY DISTRIBUTIONS AND THE TWO-COMPONENT PICTURE OF PARTICLE PRODUCTION. Fialkowski, K.; Miettinen, H. I. (Rutherford High Energy Lab., Chilton, Eng.). Phys. Lett.; 43B: No. 1, 61-64(8 Jan 1973).

The two-component model is shown to provide a very good description of the energy dependence of the topological cross sections for pp collisions in a wide energy range (15 to 300 GeV/c). The cross sections are decomposed into diffractive and nondiffractive parts. A dip is predicted to develop in the multiplicity distribution in the ISR energy range. (auth)

21223 SOME NEW ASPECTS IN THE QUASICLASSICAL THEORY OF HEAVY-ION TRANSFER REACTIONS. Kleber, M.; Beck, R. (Technische Univ., Munich). Phys. Lett.; 43B: No. 2, 98-100(22 Jan 1973).

Predictions for the Q value in heavy-ion transfer reactions are derived by using the method of path integrals. A prescription for the intermediate classical Rutherford orbit which allows for changes of the particle parameters is given. The influence of Coulomb excitation on the Q value is estimated in the liquid-drop model. (auth)

21224 CORRELATION CORRECTIONS TO SHELL MODEL VALUES OF DIPOLE SUM RULES. Lane, A. M. (Atomic Energy Research Establishment, Harwell, Eng.); Mekjian, A. Z. Phys. Lett.; 43B: No. 2, 105-107(22 Jan 1973).

Shell-model values of photonuclear cross-section integrals $\int(\sigma/E)dE$ are 40% larger than observed values. A simple (non RPA) method for correlation corrections removes the discrepancy. Application to the isotensor term invalidates the recent evaluation of neutron radius from photonuclear data. (auth)

21225 ENERGY DEPENDENCE OF THE OPTICAL POTENTIAL. Sinha, B. (King's Coll., London); Srivastava, D. K.; Ganguly, N. K. Phys. Lett.; 43B: No. 2, 113-116(22 Jan 1973).

It is important to take into account the intrinsic energy dependence of the optical potential arising from the energy dependence of the separation distance of the two-body effective interactions used for calculating the optical potential. The consequence of such an energy dependence for both the direct and exchange terms is discussed. (auth)

21226 TWO-PARTICLE TRANSFER FORM FACTORS. Ibarra, R. H. (Univ. of Manchester, Eng.). Phys. Lett.; 43B: No. 1, 6-8(8 Jan 1973).

An approximate method is set up in which the overlap integral of the nuclear wave functions involved in the two-particle transfer reaction emerges as the solution of an inhomogeneous differential equation. Structure effects due to the residual interaction ensure the correct asymptotic dependence in the form factor. The method is illustrated by a simple calculation of the form factor for the ^{42}Ca(p, t) reaction. (auth)

21227 METHOD OF GENERALIZED DENSITY MATRIX IN COLLECTIVE EXCITATION THEORY. Belyaev, S. T.; Zelevinskii, V. G. (Inst. of Nuclear Physics, Moscow). Yadern. Fiz.; 16: No. 6, 1195-1208(1972). (In Russian).

A method is proposed to consider collective nuclear excitations connected with generalization of usual equations of motion for density matrix in self-consistent field approximation for the problems with strong coupling of single-particle and collective degrees of freedom. Equations for density matrix are considered in expanded space, that explicitly includes collective excitations. The new method was used in solving the problem of pairing and of translational motion of nucleus. Operator formalism, that allows one to follow the fulfillment of conservation laws at all stages of calculation has been developed. (auth)

21228 DEVIATIONS FROM AXIAL SYMMETRY AT SCISSION. Schultheis, H.; Schultheis, R. (Univ., Munich). Lett. Nuovo Cim.; 6: No. 5, 169-172(3 Feb 1973).

To gain some insight into the axial symmetry at the end of the fission process the potential energy of scission point configuration was calculated with allowance for γ deformations. The scission configuration was described by two triaxial ellipsoidal fragments in contact. The shape of the scission configuration was assumed to be approximately determined by the equilibrium of Coulomb repulsion and deformation energy. The calculated kinetic energy is plotted as a function of fragment mass for ^{236}U. The maximum of the kinetic energy at the mass ratio 132/104 and the slopes toward symmetric and asymmetric fission are well reproduced. It is shown that the calculated kinetic energy values indicate that the β deformations assumed for the scission configuration were reasonable, even though the intrinsic fragment excitation was neglected. The potential energy of nonaxial distortions was studied for the following primary fragment pairs: ^{80}Ge + ^{156}Nd, ^{94}Se + ^{142}Ce, ^{98}Sr + ^{138}Xe, and ^{112}Ru + ^{124}Cd. It was found that the potential energy at scission favors axial asymmetry for the fission mode ^{98}Sr + ^{138}Xe and axial symmetry for the others. The results indicate that the gain in energy due to deviations from axial symmetry at scission is small. If this is typical for all mass ratios, the results justify the usual assumptions of axial symmetry in quasi-static calculations of the kinetic and excitation energies of the fragments. The influence of γ distortions near scission, however, depends on the mass ratio of the fragments. This result suggests that axial asymmetry and left-right asymmetry are strongly correlated on the slope towards scission. The correlation should be important for the damping of deviations from axial symmetry occurring at the top of the barrier. (3 figures). (RWR)

21229 PHASE-SHIFT AND POTENTIAL-MODEL ANALYSIS OF EXPERIMENTAL INFORMATION. Signell, P. (Michigan State Univ., East Lansing). pp 9-27 of Two-body force in nuclei. Austin, S. M. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on the Two-Body Force in Nuclei; Ann Arbor, Michigan, United States of America (USA) (7 Sep 1971). See CONF-710915-.

Recent developments in phenomenological potentials are sketched first. The bulk of the paper concerns the phase shifts predicted by the potentials. Potentials considered are of the following types: hard core, boundary condition, OBE, separable, soft core, energy-dependent phase shift representation, and finite core. Phase shifts for isospin one and zero are shown. (32 figures) (RWR)

21230 ELEMENTARY-PARTICLE MODELS OF THE TWO-NUCLEON FORCE. Brown, G. E. (State Univ. of New York, Stony Brook). pp 29-42 of Two-body force in nuclei. Austin, S. M. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on the Two-Body Force in Nuclei; Ann Arbor, Michigan, United States of America (USA) (7 Sep 1971). See CONF-710915-.

It is first shown that the two-pion-exchange potential cannot be represented by a one-boson exchange, and that the nucleon-nucleon force cannot be explained by one-boson-exchange potentials. Calculation of the two-pion exchange contribution to the scattering matrix is then addressed. $f + 0(t)$, the amplitude for emitting two pions in a $J = 0$, isospin-symmetric state, is evaluated; from $f + 0$ one can describe the force arising from the exchange of scalar, $T = 0$ objects with a continuum of masses. The Born amplitude and the contribution of the ρ meson to the $f^1_1(t)$ amplitude are shown, along with the results for F-wave nucleon-nucleon scattering using the OPE amplitude plus the two-pion-exchange amplitude. The results indicate that the nucleon box diagram without pair suppression gives much too much intermediate-range attraction in the channel for exchange of spin-zero isoscalar mesons of various masses. (6 figures) (RWR)

21231 DEVELOPMENT OF A SUPER SOFT CORE POTENTIAL MODEL OF THE NUCLEON-NUCLEON INTERACTION. de Tourreil, R.; Sprung, D. W. L. pp 43-47 of Two-body force in nuclei. Austin, S. M. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on the Two-body Force in Nuclei; Ann Arbor, Michigan, United States of America (USA) (7 Sep 1971). See CONF-710915-.

Work directed toward producing a complete super-soft-core potential that provides an excellent fit to phase shifts and other two-body data and includes the OPEP tail is discussed. The forms employed are essentially Yukawas modified by Gaussian or similar cutoff functions to keep the potential soft at short distances. Acceptable forces were found in three of the four spin-isospin subspaces, and the remaining singlet-odd state presents no difficulty. Noteworthy characteristics of the potential are discussed, and some preliminary potentials are included. (1 figure) (RWR)

21232 TWO-PION-EXCHANGE NUCLEON-NUCLEON POTENTIAL. Chemtob, M.; Durso, J. W.; Riska, D. O. pp 48-50 of Two-body force in nuclei. Austin, S. M. (ed). New York; Plenum Publishing Corp. (1972).

From Symposium on the Two-Body Force in Nuclei; Ann Arbor, Michigan, United States of America (USA) (7 Sep 1971). See CONF-710915-.

Results of two important modifications to earlier theoretical derivations of the nucleon-nucleon potential are reported. As much information from $\pi + N \to \pi + N$ and $N + \overline{N} \to \pi + \pi$ processes as is currently available from theoretical descriptions is included. The Blankenbecler-Sugar-Logunov-Tavkhelidze equation is used to define the potential. Potentials resulting from several assumed models for $\pi + N \to \pi + N$ and $N + \overline{N} \to \pi + \pi$ processes are shown. In most cases the calculated potential is close to the phenomenological Hamada-Johnston potential, particularly at distances greater than 1 F. It is significant that the corrections made by including $\pi\pi$ correlations by means of the s- and p-wave $N + \overline{N} \to \pi + \pi$ helicity amplitudes almost invariably improve the agreement. (4 figures) (RWR)

21233 OFF-ENERGY-SHELL EFFECTS IN MANY-NUCLEON SYSTEMS. Tabakin, F. (Univ. of Pittsburgh). pp 101-121 of Two-body force in nuclei. Austin, S. M. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on the Two-Body Force in Nuclei; Ann Arbor, Michigan, United States of America (USA) (7 Sep 1971). See CONF-710915-.

Calculations that demonstrate the great need for improved knowledge of the short-range two-nucleon wave function are discussed. Three points emphasized are off-shell freedom, large systematic changes occurring in many-body calculations, and the need for additional constraints. Generation of sets of phase shift-equivalent potentials using unitary transformations is discussed, along with parallel Brueckner calculations of the binding energy of ^{16}O and of nuclear matter. Systematic rules relating the binding of finite nuclei to equivalent nuclear matter are revealed. It is found that appreciable systematic changes in calculated binding energies are obtained when the excitation parameter is altered. Further, the ^{16}O and nuclear matter results, including the Bethe-Goldstone wave functions, are closely related (except for the D-wave suppression effect). (7 figures, 1 table) (RWR)

21234 EFFECTIVE REACTION MATRIX DERIVED FROM NUCLEAR MATTER CALCULATIONS. Bethe, H. A. (Cornell Univ., Ithaca, NY). pp 133-154 of Two-body force in nuclei. Austin, S. M. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on the Two-Body Force in Nuclei; Ann Arbor, Michigan, United States of America (USA) (7 Sep 1971). See CONF-710915-.

The nuclear interaction as derived from nuclear matter theory is discussed. The main result of the theory, the energy per nucleon of nuclear matter, is shown as a function of nucleon density, along with the contributions of S, P, and D states to the nuclear matter potential energy; a number of corrections to the potential energy are tabulated. The results are then applied to finite nuclei. The work of Negele (Phys. Rev. C1, 1260(1970)) is reviewed in this connection. The direct and exchange parts of the potential are shown. These are followed by the charge, neutron, and proton density distributions for some closed-shell nuclei, along with the total binding energies per particle. The differential cross section for

electron scattering by ^{40}Ca at 750 MeV is presented. Finally, the parameters of nuclear matter for several two-body interactions are tabulated. (13 figures, 5 tables) (RWR)

21235 EFFECTIVE TWO-BODY INTERACTION IN FINITE NUCLEI AND ITS CALCULATION. Barrett, B. R. (Univ. of Arizona, Tucson). pp 155-175 of Two-body force in nuclei. Austin, S. M. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on the Two-Body Force in Nuclei; Ann Arbor, Michigan, United States of America (USA) (7 Sep 1971). See CONF-710915-.

The calculation of the effective interaction and other effective operators in finite nuclei is an important link in the chain connecting microscopic phenomena, such as the nucleon-nucleon scattering phase shifts, with nuclear phenomena, such as cross sections and excitation energies. It is strongly dependent upon links having to do with the theory of the nucleon-nucleon interaction, the treatment of strong short-range correlations, and the derivation of the single-particle shell model. Work on the theory of effective operators and their calculation is reviewed. A theory justifying the truncation of the wave function into a small model space of a few active valence orbitals is developed, and an expression for the effective interaction in this space is found which can be expressed in a diagrammatic perturbation expansion. (10 figures) (RWR)

21236 SOLUTION OF THE BETHE-GOLDSTONE EQUATION IN FINITE NUCLEI FROM N-N PHASE SHIFT DATA. Hodgson, R. J. W. (Univ. of Ottawa, Ont.). pp 177-181 of Two-body force in nuclei. Austin, S. M. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on the Two-Body Force in Nuclei; Ann Arbor, Michigan, United States of America (USA) (7 Sep 1971). See CONF-710915-.

A method used to calculate the reaction matrix in finite nuclei which employs harmonic-oscillator matrix elements that have been determined from the free N-N phase shift data is outlined. It allows for the exact treatment of the Pauli operator and for a simple and rapid way of studying the effect of a variation of the intermediate-state energy. The results are applied to the calculation of the energy levels of ^{18}F and ^{18}O; a shell model with an inert ^{16}O core is used. The results for ^{18}O are reasonably good, but the lowest levels of ^{18}F are underbound by about 3 MeV. This underbinding appears to be due to the effective interaction in the 3S-3D states. (2 figures) (RWR)

21237 TWO-BODY INTERACTION IN NUCLEAR SHELL MODEL CALCULATIONS. McGrory, J. B. (Oak Ridge National Lab., TN). pp 183-203 of Two-body force in nuclei. Austin, S. M. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on the Two-Body Force in Nuclei; Ann Arbor, Michigan, United States of America (USA) (7 Sep 1971). See CONF-710915-.

Work on the properties of low-lying bound states of light nuclei in terms of the conventional nuclear shell model is reviewed, particularly with respect to the structure of nuclei in the 0p, 0d-1s, and 0f-1p shells. A conventional shell-model calculation is first defined, and how the effective two-body interaction is introduced into the calculation is indicated; the types of two-body interaction used, typical of most shell-model calculations, are also discussed. The sort of agreement with experimental data obtained for nuclei in the s-d shell is illustrated for energy levels, strengths in single-nucleon-transfer reactions, and electric quadrupole and magnetic dipole moments and transition rates. The sensitivity of these calculated results to the differences between the various interactions used is discussed. The renormalization of the effective two-body interaction that occurs when the model space is truncated to include only part of a complete oscillator shell is examined. It is well known that the shell model works because it is possible to "hide" a considerable amount of configuration mixing that occurs in actual nuclear wave functions through renormalization of the two-body interaction; the role that the individual orbits play in an s-d-shell-model calculation is illustrated. Energy levels are shown for ^{21}Ne and ^{44}Sc, as are matrix elements and quadrupole moments for light nuclei. (2 figures, 6 tables) (RWR)

21238 EFFECTIVE NUCLEON-NUCLEON INTERACTION DEDUCED FROM NUCLEAR SPECTRA. Schiffer, J. P. (Argonne National Lab., IL). pp 205-227 of Two-body force in nuclei. Austin, S. M. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on the Two-Body Force in Nuclei; Ann Arbor, Michigan, United States of America (USA) (7 Sep 1971). See CONF-710915-.

The energy-level schemes of nuclei differing from closed shells by only two nucleons can yield the matrix elements of the residual interaction between two nucleons. Nuclides from A = 32 to 209 are examined. It is shown that there is a remarkable similarity in the behavior of the experimental two-nucleon matrix elements throughout the periodic table. The data suggest that the real effective interaction in nuclear matter is rather well defined and that the large admixtures appearing in shell-model calculations are symptoms of quite uniform effects appearing throughout. (20 figures, 7 tables) (RWR)

21239 DOES AN EFFECTIVE E2 OPERATOR HAVE A TWO-BODY PART? Khanna, F.; Harvey, M.; Sprung, D. W. L.; Jopko, A. (Chalk River Nuclear Labs., Ont.). pp 229-234 of Two-body force in nuclei. Austin, S. M. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on the Two-Body Force in Nuclei; Ann Arbor, Michigan, United States of America (USA) (7 Sep 1971). See CONF-710915-.

A general theory for the effective transition operators as needed in the nuclear shell model that has recently been formulated is briefly reviewed. The question whether the transition rates in the A = 18 system can be quantitatively estimated by including only the effective charge calculated for the A = 17 system with small corrections due to the Pauli exclusion principle is examined. Two different approaches are used, and results of the calculations are discussed. From the study of the effective operators with realistic interactions, it appears that the two-body part of the effective E2 operator can be quite large as compared with the one-body part of the effective E2 operator. It can perhaps give some dramatic effects, like the sharp decrease in the effective charge needed for ^{18}F. (1 table) (RWR)

21240 DESCRIPTION OF INELASTIC (p,p') SCATTERING. Schaeffer, R. (CEN, Saclay, France). pp 245-264 of Two-body force in nuclei. Austin, S. M. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on the Two-Body Force in Nuclei; Ann Arbor, Michigan, United States of America (USA) (7 Sep 1971). See CONF-710915-.

The reliability of information on excited states of nuclei obtained by inelastic proton scattering is assessed. The DWBA is described first, and this is followed by an examination of the vibrational model. It is shown that exchange effects may be expected to be very important in inelastic proton scattering, and they are considered in some detail (specifically, with respect to scattering by ^{40}Ca). The approximate treatment of the exchange term in the DWBA matrix element by Petrovich, et al. (Phys. Rev. Lett., 22: 895(1969)), is discussed; and it is shown that the approximation is rather good, except at low energies, when the interacting particles stay far from each other. By considering pairs of nuclides, one with a closed proton shell and the other with a closed neutron shell, it can be shown that neutron and proton behave much more symmetrically than predicted by the current nuclear models. In conclusion, exchange effects must be included in proton inelastic scattering. They explain both the angular momentum transfer and the energy dependence of the observed cross sections, whereas a DWBA calculation with the direct contribution fails to explain either. If exchange effects are included, on the other hand, and realistic forces are used, the DWBA appears as a quantitative, parameter-free theory of proton inelastic scattering, which can be used to extract spectroscopic information on nuclear excited states. (8 figures, 2 tables) (RWR)

21241 CORE POLARIZATION EFFECTS IN (p,p') REACTIONS. McManus, H. (Michigan State Univ., East Lansing). pp 265-284 of Two-body force in nuclei. Austin, S. M. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on the Two-Body Force in Nuclei; Ann Arbor, Michigan, United States of America (USA) (7 Sep 1971). See CONF-710915-.

Core polarization is well established in the interpretation of experimental phenomena in terms of the shell model. It arises from the excluded part of the vector space; in general, one must deal with effective operators, which take into account the degrees of freedom not explicitly described. Attention is centered on long-range correlations between nucleons, which are important in the low-excitation spectra and in the structure of transition operators for relatively low-lying excitations and in the case of inelastic scattering for momentum transfers up to 1.5 F^{-1}. The following points are emphasized: if a shell-model basis is adopted and the matrix elements of the effective interaction are found by fitting to experimental spectra, these matrix elements differ very considerably from those of the bare G matrix; in interpreting electromagnetic transitions it is necessary to introduce quantities like polarization charges; simple lowest-order perturbation treatments usually lead to effective interactions and operators that are much closer to experiment than the bare operators. A method for estimating the importance of core polarization in calculations is discussed, and the effects of core polarization are illustrated in proton inelastic scattering by ^{50}Ti, ^{89}Y, ^{90}Zr, ^{207}Pb, and ^{209}Bi. (7 figures) (RWR)

21242 EFFECTIVE TWO-NUCLEON INTERACTION FROM INELASTIC PROTON SCATTERING. Austin, S. M. (Michigan State Univ., East Lansing). pp 285-304 of Two-body force in nuclei. Austin, S. M. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on the Two-Body Force in Nuclei; Ann Arbor, Michigan, United States of America (USA) (7 Sep 1971). See CONF-710915-.

Since inelastic scattering cross sections depend on a nuclear matrix element containing both the wave functions of the nuclear states involved and the effective interaction, V_{eff}, between the projectile and the target nucleons, it is necessary to have an a priori value of V_{eff} before one can use inelastic scattering as a tool for nuclear spectroscopy. An approach to determining V_{eff}, entirely empirical in nature, is explored in detail. One examines transitions where the wave functions are well known and adjusts the strength of the two-body interaction to fit the observed cross sections. If the results for a representative sample of cases are consistent, one has obtained a workable interaction for spectroscopic studies. After a short historical review, the theoretical formalism is briefly outlined. Then the experimental information on the central (or scalar) part of V_{eff} is examined. Work on the tensor and spin-orbit parts of the force is considered next, and the imaginary part of the effective interaction is briefly discussed. Present knowledge may be summarized as follows for a Yukawa of 1.0 F range (subscripts 0, σ, τ, T, and LS refer to central, spin, isospin, tensor, and spin-orbit parts, respectively): V_0, 27 ± 5 MeV; V_σ, poorly determined; V_τ, poorly determined, hopeful; $V_{\sigma\tau}$, 12 ± 2.5 MeV; V_{T_τ}, consistent with OPEP; and V_{LS}, poorly determined, hopeful. (8 figures, 6 tables, 48 references) (RWR)

21243 MICROSCOPIC DESCRIPTION OF INELASTIC SCATTERING AND CHARGE EXCHANGE WITH COMPLEX PROJECTILES. Madsen, V. A. pp 315-332 of Two-body force in nuclei. Austin, S. M. (ed.). New York; Plenum Publishing Corp. (1972).

From Symposium on the Two-Body Force in Nuclei; Ann Arbor, Michigan, United States of America (USA) (7 Sep 1971). See CONF-710915-.

The author begins with a discussion of the microscopic formalism. Forces obtained empirically in nucleon scattering are compared. Empirical forces obtained from analysis of strong transitions produced by complex projectiles are a little stronger than the corresponding free-nucleon interactions. Effective complex-projectile-target-nucleon interactions compared with those deduced from effective nucleon-nucleon interactions using a folding procedure show good agreement; the same is true for the average tensor force. Next, the method of Feshbach (Ann. of Phys., 5: 357 (1958)) and the concepts of effective nuclear interaction are used to develop the idea of nuclear effective interaction in reaction theory. The purpose is to obtain coupled-channels equations that can serve as a starting point for making nuclear reaction calculations. Antisymmetry is included in the equations obtained by a procedure that is convenient for calculating antisymmetrized amplitudes to second order. Finally, the extent to which features from direct reaction theory with simple local forces are retained if one considers mechanisms beyond ordinary direct scattering is examined. (6 figures, 1 table) (RWR)

PHYSICS (PLASMA AND THERMONUCLEAR)

21244 PLASMA PHYSICS INDEX. Volume 8, No. 1, 1973. Bibliography, Author Index, Subject Index. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 129p.

This listing includes 344 references. (MOW)

Confinement and Heating

Refer also to abstracts 21343 and 21435.

21245 (CEA-CONF-2138) ION HEATING MECHANISMS BASED ON THE ABSORPTION OF THE FAST HYDROMAGNETIC WAVE AROUND THE ION CYCLOTRON FREQUENCY. Adam, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1972. 23p. (CONF-720961-7). Dep. NTIS (U. S. Sales Only).

From Symposium on Plasma Heating and Injection; Varenna, Italy (21 Sep 1972).

The following damping mechanism for magneto-acoustic hydromagnetic waves are discussed: (1) collisional damping, (2) cyclotron damping, (3) harmonic cyclotron damping, and (4) amplitude of the wave. The advantages of using hydromagnetic waves for direct heating are briefly described. (MOW)

21246 (COO-3165-3) FUNDAMENTAL STUDIES OF TURBULENT HEATING OF A PLASMA. Annual Progress Report, April 1, 1972-March 31, 1973. Korn, P.; Wharton, C. B. (Cornell Univ., Ithaca, N.Y. Lab. of Plasma Studies). [nd]. Contract AT(11-1)-3165. 12p. Dep. NTIS.

During the past year the investigation was continued of scaling laws and on optimizing the experiment as a plasma heating device. Three main conclusions from these investigations are described: (1) The plasma resistivity is anomalously large during turbulent heating, approaching the "Buneman" value normally associated with the electron 2-stream instability, yet the observed turbulent spectrum is more appropriate for ion acoustic waves; (2) The ion energy distribution is nonMaxwellian, but nearly isotropic. It has two kinds of small anisotropies, each in opposite directions; (3) The turbulent heating limits itself before the peak of the current is reached. During the summer of 1972, in collaboration with the University of Texas, experiments were conducted on the third phase of joint experiments on rf ion heating of the preheated (collisionless) THM plasma. Up to 1 MW at 6 MHz was impressed, yielding resonant heating at ω_{ci} and $2\,\omega_{ci}$, with final plasma energies of $310 < (T_e + T_i) < 380$ eV in a 4-liter volume at 3×10^{13} cm^{-3}. Explicit results are given. (MOW)

21247 (IPPJ-123) STOCHASTIC CHARACTER OF ELECTRON CYCLOTRON HEATING IN A NONUNIFORM MAGNETIC FIELD. Kawamura, T.; Namba, C.; Terashima, Y. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Apr 1972. 10p.

The rf heating process of electrons in mirrors is thought to be stochastic due to the nonadiabatic effect before the electron energies reach some critical values. To attain higher energies, other cause of phase randomization should be considered. (auth)

21248 (IPPJ-126) INHOMOGENEOUS EFFECT ON COIL-TO-PLASMA COUPLING IN ION CYCLOTRON WAVE. Toyama, H.; Matsuura, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1972. 26p.

Dependence of absorbed rf power on the diameter of a plasma column was examined experimentally in the density region of 10^{11} to 2×10^{12} cm^{-3}, using the QP machine. When the absorbed rf power is proportional to a^{γ} (a is the diameter of plasma column), calculation on the uniform plasma column shows $\gamma = 4$. However, the experimental value of γ was less than 2. It is shown that the effect of an inhomogeneous density profile makes γ lower than 2 and that the density profile is important to heat a plasma efficiently. (auth)

21249 (JAERI-M-4842) INFLUENCE OF THE ERROR FIELD ON THE PLASMA CONFINEMENT IN THE TOKAMAK DEVICE. Matsuda, S.; Yoshikawa, M. (Japan Atomic Energy Research Inst., Tokyo). Jun 1972. 39p. (In Japanese).

A stabilized confinement of the tokamak plasma is attained by the complex magnetic field produced by the different types of coils and conducting shells. One important characteristic of the plasma is the axisymmetry. It is not possible to design the device with a complete axisymmetry, due to gaps in the shell and the yoke of a current transformer core and also to the misalignment of coils and their leads. The consequence is occurrence of the error field. The influence of the error field on the plasma confinement, during all the stages of plasma production, is calculated. (auth)

21250 DYNAMICS OF HEATING OF COMPLETELY IONIZED PLASMA BY FOCUSED LASER LIGHT. Zakharov, S. D.; Tyurin, E. L.; Shcheglov, V. A. Kvantovaya Elektron. (Moscow); No. 3, 106-108(1971). (In Russian).

Expressions are given to determine the thermal conditions in a completely ionized plasma which is heated by a spherically focused laser beam. The relation between the laser light intensity and the temperature distribution in the plasma is analyzed to define optimal heating conditions. (IAA)

21251 HEATING OF A THETA-PINCH PLASMA BY CO_2 LASER RADIATION. Engelhardt, A. G.; Fuchs, V.; Neufeld, R.; Richard, C. (Hydro-Quebec Research Labs., Varennes). Kvantovaya Elektron. (Moscow); No. 5, 105-108(1971). (In Russian).

A possible technique is suggested for heating a theta-pinch plasma by transverse light pulses of about 300 nsec from a CO_2 laser. Theoretical considerations and some experimental observations are given to substantiate the feasibility of this plasma heating method. Conditions for a trial experiment are discussed. (IAA)

21252 ANOMALOUS HEATING OF PLASMAS BY LASER IRRADIATION. Kaw, P.; Dawson, J.; Kruer, W.; Oberman, C.; Valeo, E. (Princeton Univ., NJ). Contract AT(30-1)-1238. Kvantovaya Elektron. (Moscow); No. 3, 3-14(1971). (In Russian).

The anomalous heating of a plasma by a superimposed electric field oscillating at a frequency close to the plasma frequency is studied. It is shown that when such an electric field is superimposed on a plasma parametric instabilities are excited which manifest themselves in an increase in ion density fluctuations. Moderate fluctuations in the intensity of the ion density cause a sharp increase in the absorption coefficient near the plasma frequency and, consequently, anomalous heating of the plasma. The absorption can increase by several orders and is essentially due to collective processes which manifest themselves particularly in the decomposition of the electromagnetic wave into ion-acoustic and longitudinal plasma oscillations. This effect is confirmed by numerical experiments, laboratory experiments with microwaves, and an experiment on radio-wave propagation in the ionosphere. A semiquantitative theory which explains the laboratory and numerical experiments is developed. (IAA)

21253 INITIAL PHASE OF THE HIGH-β COMPACT TORUS EXPERIMENT TEE. Belitz, H. J.; Kugler, E.; Noll, P.; (and others) (Kernforschungsanlage, Juelich, Ger.). p 9 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

This experiment was built to study the β limitation of plasma confinement in a tokamak-like configuration with a small aspect ratio and currents near the Kruskal-Shafranov limit. Results on the fast plasma heating phase are presented. They indicate the range of plasma parameters attainable at the start of the confinement phase. (France)

21254 WAVE INFLUENCE ON CROSS-FIELD DIFFUSION. Rosenbluth, M. N.; Liu, C. S. (Inst. for Advanced Study, Princeton, NJ). p 12 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Two supplementary effects to cross-field diffusion in plasma slabs are considered: a very small magnetic shear eliminates the convective-cell enhancement pointed out by Taylor, Dawson, et al, and the long mean free path of plasmons leads to a surprisingly large effect. (France)

21255 NEOCLASSICAL TRANSPORT IN A STRONG MAGNETIC FIELD. Dum, C. T.; Pfirch, D. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). p 13 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The effect of a strong magnetic field on collisions is investigated. The results are applied to neoclassical transport. Except for extremely strong magnetic fields, neoclassical transport is not modified significantly. (France)

21256 NEOCLASSICAL TRANSPORT IN TOKAMAKS AND THE EFFECTS OF NEUTRAL GAS. Duechs, D. F. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). p 14 of Fifth Euro-

pean Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Two types of neoclassical transport codes were applied to the tokamak discharge: a simplified 3-regime thermal transport code neglecting mass transport; and a pure-banana-regime code including mass transport and neutral gas influx. A neoclassical code is now used operating in both banana and plateau regime, mass transport, neutral gas influx, and four generations of charge-exchange neutrals being included. (France)

21257 NEOCLASSICAL TRANSPORT EFFECTS IN A STELLARATOR. Connor, J. W.; Hastie, R. J.; Taylor, J. B. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). p 15 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Neoclassical diffusion in a stellarator at collision frequencies comparable with bounce and transit frequencies is considered and shown to be identical to axisymmetric diffusion until superbanana effects dominate. Expressions for superbanana diffusion and ion heat flux are given. The relation between diffusion and toroidal current is considered. (France)

21258 NONLINEAR THEORY OF ION CYCLOTRON HEATING. Canobbio, E.; de Barbieri, O. (CEN, Grenoble, France). p 16 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

A brief outline of a rigorous derivation of the damping of a small amplitude cyclotron wave by a plasma in straight geometry at very small collision frequencies is given for the first time, using the exact particle trajectories and the full Fokker–Planck collision operator. (France)

21259 INFLUENCE OF THE TIME MODULATION OF THE TOROIDAL ELECTRIC FIELD ON THE NEOCLASSICAL DIFFUSION OF A TOKAMAK PLASMA. Nocentini, A. (Univ., Trieste, Italy). p 17 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The effect of modulating the external, toroidal electric field which drives the tokamak discharge is considered. A pinch effect due to the combined effect of the toroidal geometry and collisions is shown to arise at frequencies much lower than the cyclotron frequency, when the oscillating part of the electric field is much larger than the oscillatory part. (France)

21260 CONCLUSIONS ON LINEAR REACTOR DEVICES FROM THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF END LOSSES FROM THETA-PINCH PLASMAS. Koeppendoerfer, W.; Schneider, W.; Sommer, J. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). p 19 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

An MHD computer code, which has been tested and improved by comparison with high-beta theta-pinch experiments, was used to calculate the decay of linear plasmas fulfilling Lawson's criterion. The necessary lengths turn out to be about twice as long as estimated from simple formulas. (France)

21261 PARAMETRIC STUDIES OF LINUS, AN ULTRA-HIGH MAGNETIC FIELD THETA PINCH. Boris, J. P.; Shanny, R. A. (Naval Research Lab., Washington, DC). p 20 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Calculations of a theta pinch in which megagauss magnetic fields and thermonuclear fusion plasmas are produced by magnetically imploding a rotating metallic liner are reported. Plasma temperatures greater than 10 keV and number densities greater than $10^{19}/cm^3$ can be sustained for times approaching 10 μsec. (France)

21262 NUMERICAL STUDIES OF DIFFUSION IN TOKAMAK CONFINEMENT. Keeping, P. M.; Grimm, R. C.; Killeen, J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). p 38 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The full set of neoclassical transport equations appropriate to tokamak confinement, with (transport) coefficients suitable for all collision frequencies, is solved numerically in the cylindrical approximation. The effects of various modifications to the neoclassical theory are presented. The code was used to help optimize the parameters for future experiments. (France)

21263 ENERGY BALANCE IN TOKAMAKS WITH ELLIPTICAL CROSS SECTION. Dnestrovskii, Y. N.; Kostomarov, D. P.; Pavlova, N. L. (Moscow State Univ.). p 39 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Études Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The energy balance in tokamak systems with magnetic surfaces having elliptical cross sections is considered. The pure noeclassical model is used without any anomalies. When the usual circular-cross-section tokamaks are considered, the results obtained using this model for the particle temperatures are in good agreement with experiment, although the energy confinement time can be much greater. (France)

21264 STUDIES OF PLASMA HEATING IN THE HIGH-BETA TOROIDAL EXPERIMENT. Newton, A. A. (United Kingdom Atomic Energy Authority, Abingdon, Eng.); Robinson, D. C.; Bodin, H. A. B.; Nalesso, G. F.; Gowers, C. W. p 44 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Studies of heating were made on the high-beta toroidal experiment, HBTX, and a 3.5-m-long straight theta pinch and the results compared with predictions of a three-fluid MHD code. The code includes multiple-arm circuits for energetically consistent calculations of the B_Z and B_θ magnetic fields. (France)

21265 SHOCK HEATING OF PLASMAS TO THERMONUCLEAR TEMPERATURE IN A MEGAVOLT THETA PINCH. Keilhacker, M.; Kornherr, M.; Maret, G.; Niedermeyer, H.; Steuer, K. H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). p 47 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Sheath formation and ion heating in a large-diameter (43 cm) high-voltage (U_0 = 500 kV) theta pinch operated at low densities (10^{12} cm^{-3} deuterium) were investigated. The sheath thickness during implosion was $8c/\omega_{pe}$ or $3c/m_{ce}$. The shock-heating results in a plasma having a temperature of between 10 and 20 eV and a β value of 0.5. (France)

21266 PARTICLE CONFINEMENT IN THE OHMICALLY HEATED PLASMA OF THE STELLARATOR URAGAN. Dikii, A. G.; Konovalov, V. G.; Kravchin, B. V.; (and others) (Physical Technical Inst., Kharkov). p 77 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Detailed investigations, taking into account the possible effect of the ohmic current on the magnetic field configuration in the stellarator, shows that the observed behavior is in agreement with the neoclassical theory which predicts (for the plateau regime) the rotational transform produced by the helical windings and the plasma current. The dependence of the time of confinement of the particle on the ohmic current amplitude is shown. (France)

21267 PLASMA CONFINEMENT EXPERIMENT IN HELIOTRON-D. Iiyoshi, A.; Morimoto, S.; Konoshima, S.; (and others) (Kyoto Univ.). p 78 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

New detailed experimental results concerning the plasma confinement in the Heliotron-D machine are reported. The diffusion coefficient of the confined helium plasma (n(e) = 10^9 cm^{-3} and T(e) = 4 eV) was studied as a function of the collision frequency, rotational transform angle, and magnetic field strength. (France)

21268 RADIAL FLUXES OF PLASMA IN STELLARATOR CAUSED BY THE DRIFT OSCILLATIONS. Volosov, V. I.; Yudin, Yu. N. (Inst. of Nuclear Physics, Novosibirsk, USSR). p 79 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Anomalous plasma losses from a stellarator have been previously shown to be explained by the interaction of the drift oscillations with trapped particles. More detailed experimental results concerning the azimuthal dependence of the plasma fluxes upon the experimental parameters (T(e), n(e) and n(0)) are given. (France)

21269 EFFECT OF AN ELECTRIC FIELD ON FLUCTUATIONS AND PLASMA CONFINEMENT IN STELLARATOR L-1. Berezhetskii, M. S.; Grebenshchikov, S. E.; Sbitnikova, I. S. (Inst. of Physics, Moscow). p 80 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

A resonance effect of the plasma potential was observed on low-order modes of fluctuations and confinement time for cases of rational magnetic surfaces. (France)

21270 UNSTABLE DECAY OF COLLISIONAL PLASMA IN PR-6 MIRROR MACHINE. Kanaev, B. I.; Yushmanov, E. E. p 82 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The free decay of a plasma ($n \simeq 10^{12}$ cm^{-3} and T(i) = 100 eV) was studied. Initially, a plasma state near the classical collision equilibrium occurred. It was discovered that the decay is followed by an increased instability resulting in losses. The instability increases with increasing initial ion temperature. (France)

21271 FOKKER–PLANCK CALCULATIONS AND FUSION ENERGY BALANCE IN MIRROR TRAPS. Werkoff, F. (CEN, Grenoble, France). p 86 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Two-coupled Fokker–Planck equations are numerically solved. The angular part of the ion distribution function is expanded into eigenfunctions of the Legendre operator and the part of the Rosenbluth potentials representing ion–ion collisions in spherical harmonics. These assumptions which are less restrictive than the ones generally used, give less-pessimistic values for the Post amplification factor. (France)

21272 COLLECTIVE SCATTERING AS A BASIS FOR 2X DECAY. Baldwin, D. E. (Univ. of California, Livermore). p 91 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

One prediction of a recently obtained expression for ion scattering from mirror machines due to the Rosenbluth–Post convective loss-cone instability is applied with good agreement to the results of the 2X and 2XII mirror experiments. (France)

21273 PLASMA CONTAINMENT IN THE STATOR II LEVITRON. Adam, J.; Bonnal, J. F.; Breton, C.; (and others) (CEN, Fontenay-aux-Roses, France). p 93 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Particle and ion energy containment times of the order of 1 ms were measured in the Stator II device. The electron energy containment time is between 10 and 20 times smaller. The total electron energy losses can be partially explained by the large impurity content in the plasma. (France)

21274 CONFINEMENT AND FLUCTUATION STUDIES IN THE JAERI HEXAPOLE. Tamura, S.; Yamato, H.; Nagashima, T.; (and others) (Japan Atomic Energy Research Inst., Tokai). p 94 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

An experiment on the effect of a magnetic field perturbation on plasma confinement in the JAERI hexapole (JFT-1) is described. The observations and the identification of low frequency instabilities (fluctuations) are presented. (France)

21275 ANISOTROPIC PLASMA CONFINEMENT IN TOROIDALLY LINKED MIRROR SYSTEMS. Cordey, J. G.; Watson, C. J. H. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). p 98 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

It is shown that there are considerable stability advantages in maintaining a strong anisotropy in the distribution functions of a plasma confined in a toroidally linked system of minimum-B mirrors. This is possible if the toroidal losses are arranged to be anomalously high, and this is compatible with an acceptably low overall loss rate. (France)

21276 PARTICLE LOSS FROM THE SPHERICAL MULTIPOLE MAGNETIC TRAP. Sadowski, M.; Skladnik-Sadowska, E.; Sudlitz, K.; Baranowski, J. (Inst. of Nuclear Research, Warsaw). p 102 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Investigations of high-order SM configurations are summarized. A simple theoretical model for the effusion of a plasma through an escape area is considered, and the conclusions are compared with experimental results. The measurement of particle loss through the point cusps along and perpendicular to the axis of the plasma injection are also described. (France)

21277 RADIOFREQUENCY PLUGGING AND HEATING THROUGH A HIGH-DENSITY SHEET PLASMA. Watari, T.; Hiroe, S.; Watanabe, T.; (and others) (Nagoya Univ., Japan). p 104 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Plugging and heating with the rf field perpendicular to the sheet plasma in a line cusp region are observed for $(\omega_{pi}/\omega_{ci})^2$ values as high as 1000. In the case of very-high-density plasmas, simplified linear theory of the sheet plasma indicates that a second resonance occurs when the sheet thickness is equal to the mean diameter of the ion cyclotron motion. (France)

21278 TOKAMAK PLASMA HEATING BY FAST-NEUTRAL INJECTION. Girard, J. P.; Khelladi, M.; Marty, D. (CEN, Fontenay-aux-Roses, France). p 105 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The injection of fast neutral particles appears to be a promising technique for heating a Tokamak plasma above the temperatures obtained by ohmic heating. A computer code was developed for calculating the behavior of the density and the ion and electron temperature profiles during the occurrence of a discharge in which the current and fast neutral-particle injection are time-programmed. (France)

21279 CLEO TOKAMAK INJECTION SYSTEM. Aldcroft, D.; Burcham, J.; Cole, H. C.; Cowlin, M.; Sheffield, J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). p 106 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Additional plasma heating in the CLEO tokamak will be provided by neutral injection. A system which produces multi-amp neutral beams of hydrogen at energies up to 30 keV is described. (France)

21280 WAVE GENERATION AND HEATING NEAR THE ION CYCLOTRON FREQUENCY IN THE ST TOKAMAK. Hooke, W. M.; Hosea, J. C. (Princeton Univ., NJ). pp 107 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

A test coil is presently being used to determine the feasibility of employing waves to further heat the ions of the tokamak plasma. Initial results for wave loading of the coil and ion heating are very encouraging. (France)

21281 PHENOMENA WHICH ACCOMPANY THE ELECTRON-CYCLOTRON HEATING IN TOKAMAK TM-3. Alikaev, V. V.; Bobrovskii, G. A.; Poznyak, V. I.; Razumova, K. A.; Sokolov, Yu. A. pp 108 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

A high power microwave generator ($\tau \leq 1$ ms, $\lambda \sim 1$ cm) was

used to investigate electron-cyclotron heating in the TM-3 installation. The increase in stored energy Δ(nT) was estimated with the diamagnetic loop signal reaching 7×10^{14} eV cm^{-3}. This can be interpreted as a temperature increase up to 1 keV for a constant $n_e \sim 10^{12}$ cm^{-3} concentration during the pulse. (France)

21282 EXPERIMENTS ON HIGH-FREQUENCY PLASMA HEATING IN A TOROIDAL MACHINE. Voitsenya, V. S.; Voloshko, A. Yu.; Longinov, A. V.; Miroshnichenko, G. A.; Nizhnik, G. Ya.; Solodovchenko, S. I. (Physical-Technical Inst., Kharkov). pp 111 of Fifth European conference on controlled fusion and plasma physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Experimental results concerning the rf heating of a plasma in the Saturn-1 machine (which is a toroidal stellarator-torsatron) are presented. (France)

21283 RF HEATING OF A THREE-COMPONENT HIGH DENSITY PLASMA IN A CLOSED MAGNETIC DEVICE. Tarasenko, V. P.; Ovchinnikov, S. S.; Kalinichenko, S. S.; Kurilko, P. I.; Shwetz, O. M.; Tolok, V. T. (Physical-Technical Inst., Kharkov). pp 112 of Fifth European conference on controlled fusion and plasma physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Excitation of plasma waves near the ion hybrid resonance in a toroidal magnetic configuration and the heating of a plasma with two ion species of different charge-to-mass ratios are considered. (France)

21284 STUDY OF PARAMETRIC INSTABILITIES AND HF TURBULENT HEATING OF A PLASMA IN LOW-HYBRID-RESONANCE CONDITIONS. Kitsenko, A. B.; Panchenko, V. I.; Stepanov, K. N.; Tarasenko, V. F. (Physical-Technical Inst., Kharkov). pp 113 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Experimental results concerning the plasma turbulent hf heating are presented. This heating is shown to be explained by the parametric instability of the plasma. (France)

21285 RF ABSORPTION IN A NONUNIFORM HOT MAGNETIZED PLASMA COLUMN. Dubois, D. M.; Messiaen, A. M.; Vandenplas, P. E. (Ecole Royale Militaire, Brussels). pp 114 of Fifth European conference on controlled fusion and plasma physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Radiofrequency absorption by a nonuniform hot plasma column described by fluid theory is discussed. The quasi-static approximation used provides a good description of the TM (transverse magnetic) excitation in the $K_H^2 \gg K_0^2$ limit. The nonuniform results are compared to the uniform results in the frequency range of interest for the rf heating ($\sim\omega_{LH}$, $\sim\omega_{ci}$, $\sim k_H V_S$). (France)

21286 EXPERIMENTAL INVESTIGATION OF THE RF PLASMA HEATING NEAR THE LOWER HYBRID RESONANCE. Capitain, J. J.; Ichtchenko, G.; Lallia, P. P.; Moulin, D.; Nguyen, T. K.; Pesic, S. S. (CEN, Grenoble, France). pp 116 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Wave absorption in the vicinity of the lower hybrid resonance was investigated. Experimental results concerning the lower hybrid resonance phenomenon were obtained and an rf heating of the dense plasma was observed. (France)

21287 REFLECTION OF PLASMA BY THE COMBINED MIRROR AT ECR. Milantiev, V. P.; Tourikov, V. A. (People's Friendship Univ., Moscow). pp 124 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The Krylov-Bogolyubov method was used to establish a consistent asymptotic theory for the relativistic motion of charged particles in the presence of a magnetic mirror under cyclotron resonance conditions. Numerical results are given. (France)

21288 BALANCE OF ENERGY IN THE REFLECTION OF PLASMA BEAM BY THE HF-SUPPLEMENTED MAGNETIC MIRROR NEAR THE ECR. Golovanivskii, K. S.; Pokhmelnykh, L. A. (Moscow State Univ.). pp 125 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The minimum hf power necessary for the reflection of a plasma beam having a longitudinal ion energy of 800 eV and a density as high as 2×10^8 cm^{-3} by the hf supplemented mirror at ecr was experimentally determined. It is shown that in this experiment quasi-adiabatic reflections occur. (France)

21289 ION HEATING BY MIXING OF WAVES NEAR ELECTRON-CYCLOTRON RESONANCE. De Kock, L. C. J. M.; Sato, T. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphass, Netherlands). pp 127 of Fifth European conference on controlled fusion and plasma physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The mixing of two large-amplitude electromagnetic waves was investigated experimentally in a mirror-confined electron-cyclotron resonance plasma produced by these waves. An increase of 0.2 eV in the value of T_i was observed when the difference in frequency of the waves was set to approximately Ω_i. (France)

21290 DECAY OF AN rf PLASMA IN DIFFERENT FIELD GEOMETRIES. Goede, A.; Hopman, H. J.; Massmann, P. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam). pp 128 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Studies of plasma density decay in different magnetic fields, demonstrated that the plasma containment times are not influenced by the field configuration. It is shown that the plasma losses are dominated by a direct streaming along the field lines. (France)

21291 SOME REGULARITIES OF PLASMA CURRENT HEATING IN TURBULENT PHYSICS. Dubovci, L. V.; Kalmykov, Yu. K.; Komin, A. V. (Scientific Research Inst. of Electrophysical Apparatus, Leningrad). pp 148 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

A phenomenological model is described for plasma heating processes occurring in turbulent discharges. Results obtained using the model with a two-temperature ion distribution are in good agreement with experiments. (France)

21292 PLASMA HEATING BY MAGNETOACOUSTIC WAVES IN THE FREQUENCY DOMAIN $\omega_{ci} \leq \omega \leq \sqrt{\omega_{ci}\omega_{ce}}$. Finken, K. H.; Laueter, R.; Tuczek, H. (Kernforschungsanlage, Juelich, Ger.). pp 149 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The effective collision frequency was determined in an rf heating experiment. Conclusions are drawn concerning the state of turbulence. (France)

21293 COLLISIONLESS HEATING OF LOW-DENSITY PLASMA BY SHOCK WAVES. Demchenko, V. V.; Hussein, A. M. (Atomic Energy Commission, Cairo). pp 166 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The possible mechanisms intervening in the turbulent heating of a low-β plasma by a collisionless shock wave are discussed under the conditions where a small-scale hf instability develops at the shock-wave front. The heating time and the effective frequency of electron and ion collisions with turbulent oscillations are estimated. (France)

21294 PLASMA HEATING AND ANOMALOUS RESISTIVITY IN HIGH-AMPLITUDE, INTERMEDIATE-FREQUENCY ELECTRIC FIELDS. Abrams, R. H.; Ohe, T.; Lashinsky, H. (Univ. of Maryland, College Park). pp 171 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The application of high-amplitude electric fields at frequencies far below the electron plasma frequency excites ion-acoustic waves and turbulence. Experimental results concerning plasma heating and anomalous resistivity are described. (France)

Diagnostics

Refer also to abstracts 21349 and 21366.

21295 (AWRE-O-56/72) TIME OF FLIGHT/ENERGY ANALYSIS OF ARC PLASMA. Powell, H. P. S.; Owen, W. D. (Atomic Weapons Research Establishment, Aldermaston (England)). Oct 1972. 20p. Dep. NTIS (U. S. Sales Only). UK 50 pence.

The use of a combined time-of-flight electrostatic analyzer to investigate the properties of the multicomponent plasma produced by an arc ion source is described. The method can be used for determining the energy–velocity distributions of the individual plasma components. (MOW)

21296 USE OF MAGNETIC PROBES FOR DIAGNOSTICS OF PULSE PLASMA. Maloch, J.; Sobra, K.; Stanek, Z. (Technical Univ., Prague). Czech. J. Phys.; 23: No. 1, 45-55(1973).

Results of the measurement of the intrinsic magnetic field of a plasma cluster and of the distribution of current density in the cluster are given. The disturbances introduced into the plasma by a probe are analyzed, and the applicability of an internal magnetic probe is verified. The construction of the probe is described. (auth)

21297 APPARATUS WITH QUADRUPOLE MASS SPECTROMETER FOR PLASMA DIAGNOSTICS OF CHARGED-PARTICLE MASSES. Egorov, V. S.; Pastor, A. A.; Plekhotkin, G. A. Vestn. Leningrad. Univ., No. 16, Fiz., Khim.; No. 3, 69-74(Aug 1972). (In Russian).

Plasma diagnostics utilizing a quadrupole mass spectrometer is discussed. The range of possible applications is illustrated by some experiments with steady and pulsed discharges. Quantitative relations between ion current and concentration of charged particles are analyzed. (auth)

21298 SUBNANOSECOND INTERFEROMETRY OF PLASMA FILAMENTS IN A LASER-PRODUCED SPARK. Richardson, M. C.; Alcock, A. J. (National Research Council, Ottawa). Kvantovaya Elektron. (Moscow); No. 5, 37-43(1971). (In Russian).

Investigation of the evolution of a spark produced in various gases (argon, xenon, neon, helium, hydrogen, nitrogen, and air at pressures from 0.5 to 8.0 atm) by a pulse of radiation from a single-mode ruby laser is described. Spark interferograms of high spatial and temporal (better than 1 nsec) resolution show that prior to the formation of the main plasma region a plasma filament is produced which moves toward the laser. The transverse dimension of the filament is an order of magnitude smaller than the diameter of the focus area. The development of the filament is viewed as the consequence of self-focusing of the laser beam. (IAA)

21299 PLASMA DIAGNOSTICS IN A PULSED DISCHARGE IN A MIXTURE CONTAINING HYDROGEN. Borodin, V. S.; Gebekov, V. D.; Kagan, Yu. M. Opt. Spectrosc. (USSR) (Engl. Transl.); 32: No. 5, 556-557(May 1972).

Translated from Opt. Spektrosk.; 32: No. 5, 1033-1035(May 1972).

Earlier papers by the authors have discussed methods of determining hydrogen plasma parameters in a pulsed discharge, based on the measurement of the time-averaged contour of the H_β line and time variation of the intensity at the center of the line. These methods are extended to the case in which hydrogen is a component of a binary mixture. Expressions are given for this system. (MOW)

21300 PLASMA DIAGNOSTICS BY CYCLOTRON RADIATION. Curatolo, M.; Engelmann, F. (Comitato Nazionale per l'Energia Nucleare, Frascati, Italy). pp 10 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

A review of diagnostic possibilities offered by cyclotron emission from a plasma is given, with special regard to high-field tokamaks. (France)

21301 HOLOGRAPHIC INTERFEROMETRY AT $\lambda = 3$ μm FOR THE MEASUREMENT OF HIGH-BETA PLASMA-DENSITY PROFILES. Braun, W. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 56 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

Holograms were produced using a pulsed hf laser. Thin metallic films were used as detectors. The sensitivity of the detector is approximately 1 joule/cm^2. A resolution of at least 150 lines/mm is obtained. It is planned to use the method for density profile measurements in high-beta plasmas. (France)

21302 NEUTRAL-PARTICLE DIAGNOSTICS BY TIME-OF-FLIGHT MEASUREMENT. Ferguson, J. D.; Kidd, D. E. (Strathclyde Univ., Glasgow). pp 57 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

The advantages of the time-of-flight technique for neutral particle diagnostics is discussed, with particular reference to efficiency at energies below 500 eV. Problems of interpretation peculiar to this technique are described in the analysis of results from a small theta pinch. (France)

21303 STUDY OF THETA-PINCH PLASMA INSTABILITIES BY MEANS OF MICROWAVE SCATTERING. Adamov, I. Yu.; Berezhnyi, V. L.; Dushin, L. A.; Kononenko, V. I.; Sisonenko, V. L. pp 58 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

Results obtained from microwave scattering ($\lambda_0 \simeq 8.16$ and 32 mm) studies of a theta-pinch plasma are presented. (France)

21304 MEASUREMENT OF THE ION ENERGY IN THE DENSE PLASMA FOCUS. Peacock, N. J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.); Forrest, M. J.; Hobby, M. G.; Morgan, P. D. pp 66 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

Laser beam scattering from the dense pinch in the plasma focus provides a set of plasma parameters which are consistent with the values derived by other techniques. Thermonuclear reactions during the dense pinch phase can only account for a small fraction of the total neutron emission. (France)

Kinetics (General)

21305 OSCILLATION MODES IN A NEGATIVE LIGHT DISCHARGE. Cathode Drop Measurement. Le Coquil, E.; Gerard, G. (Centre National d'Etudes des Telecommunications, Lannion, France). Compt. Rend., Ser. D; 275: No. 19, 685-688(6 Nov 1972). (In French).

In a negative light discharge created in a hollow-cathode device, various pure oscillation modes having power of the order of watts were observed. The mode frequencies are related to the transit time in the plasma and the cathode sheath. The variation of the oscillation frequency with the intercathode distance is in agreement with the theory, and cathode drops can be measured. (FR)

21306 CURRENT TRAPPING IN TOROIDAL HIGH-CURRENT DISCHARGES. Ellis, W. R.; Newton, A. A. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Plasma Phys.; 14: No. 12, 1101-1108(Dec 1972).

Observations have been made of induced toroidal discharges (in a quartz torus major radius 32 cm, internal minor radius 4.1 cm and at filling pressures from 2 to 50 mtorr of hydrogen) in conditions where the electrical breakdown lag is comparable with the rise time (1.6 μs) of the driving field. A current (peak value 45 kA) flows in the gas which has a unidirectional component of 20 kA which persists after the driving field has decayed. Measurements of this component, the "trapped current," agree quantitatively with the results of circuit analysis. Dissipation of the trapped current in 50 μs gives 60% of the initial circuit energy (1.6 kJ) to the gas. The resulting plasma has an average ionization of 50% with an electron density of $\sim 10^{15}$ cm^{-3} and an electron temperature on axis of about 20,000 K which can be used as the preionization stage for high-energy compression experiments. (auth)

21307 INTERRELATIONSHIP OF ADSORPTION PROCESSES ON A CATHODE SURFACE AND OF THE PROCESSES IN THE NEAR-ELECTRODE REGION OF THE HIGH-CURRENT DISCHARGE IN A PLASMA. Karasev, V. N.; Munyatov, A. V.; Pankratov, V. G.; Stepanov, V. N. Zh. Prikl. Mekh. Tekh. Fiz.; No. 5, 29-32(1972). (In Russian).

The characteristics of the electrode coating by plasma material determined the magnitude of the work function of the electrode and influenced the current density in a discharge and the magnitude of the near-cathode potential drop. On the other hand, the degree of coating of the cathode by adsorbed particles depended essentially on this potential drop. A method is advanced for calculating the emission characteristics of the cathode during a high-power dis-

charge in a plasma allowing for the above interrelationships. The problem was solved in a one-dimensional arrangement for a thermo-emissive autodischarge (a discharge "without a spot"). (tr-auth)

21308 HIGH-SPEED ELECTRODYNAMIC HIGH-PRESSURE GAS INJECTOR. Aretov, G. N.; Vasil'ev, V. L; Khamidullin, F. R. Instrum. Exp. Tech. (USSR) (Engl, Transl.); 15: No. 3, 878-880 (1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 219-222(1972).

The construction and the results of testing a gas injector for plasma accelerators having a volume of 20 cm^3 under the valve at a pressure of 100 kg/cm^2 are described. Pre-acceleration of the valve up to 35 m/sec before the beginning of injection was used to increase the gas-density gradient. An interferometric study was made of the gas-density distribution in the space at fixed times. (auth)

21309 FIFTH EUROPEAN CONFERENCE ON CONTROLLED FUSION AND PLASMA PHYSICS. Volume 1. Contributed Papers. Conference held at Grenoble, France, August 21–25, 1972. Grenoble, France; Centre d'Etudes Nucleaires (1972). v p. (CONF-720804–).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972).

Separate abstracts were prepared for 167 of the included papers. Abstracts for 11 other papers have appeared previously in NSA; see NSA 26: 44446, 49561, 49604, 54752, 54753, 54806, 54808, 54828, 54845, 60287, and 60295. (MOW)

For abstracts of individual papers see: 19767, 19768, 21253–21294, 21300–21304, 21310–21324, 21326–21345, 21354–21360, 21366–21370, 21376–21409, 21414–21422, and 21432–21459.

21310 RELAXATION OF THE ION DISTRIBUTION FUNCTION IN THE DECA II B MAGNETIC WELL. Launois, D.; Lecoustey, P.; Tachon, J.; Kesner, J.; Chatelier, M. (CEN, Fontenay aux-Roses, France). pp 83 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

The comparison of the measurement and the calculation of the angular and energy distributions of the confined ions, shows that Coulomb collisions can explain the energy containment in a circularized quadrupolar magnetic well. (France)

21311 CYCLOTRON RADIATION STUDY OF THE ANGULAR DIFFUSION OF A MIRROR-CONFINED HOT-ELECTRON PLASMA. Jacquinot, J.; Waldes, J. (CEN, Fontenay-aux-Roses, France). pp 84 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

The decay of hot electron plasmas due to collisions involving rare gas atoms in a magnetic well was studied from observations of the emitted synchrotron radiation. Good agreement between theory and experiment was obtained for several gases and mirror ratios for both the line shape and the decay of the line maxima. (France)

21312 EVOLUTION OF THE ANGULAR DISTRIBUTION FUNCTION OF A MIRROR-CONFINED HOT-ION PLASMA. Jacquinot, J.; Leloup, C.; Poffe, J. P.; de Pretis, M.; Ripault-Misguich, J. (CEN, Fontenay-aux-Roses, France). pp 85 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

The evolution of the angular distribution function is studied for the Bille en Tete M. E. mirror device with a plasma having n(i) approximately 5×10^{11} cm^{-3} and $\langle E(i) \rangle$ approximately 1.5 keV. (France)

21313 SPACE STRUCTURE OF THE AMBIPOLAR POTENTIAL IN MIRROR MACHINES. de Barbieri, O. (CEN, Grenoble, France). pp 87 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

The space structure of the ambipolar potential in a mirror machine is studied for a wide class of trapped-particle distributions. It is found that the charge-neutrality potential may easily be a nonmonotonic function of position and an explanation is given of this effect. (France)

21314 COLLECTIVE PHENOMENA IN A PENNING DISCHARGE IN A STRONGLY INHOMOGENEOUS MAGNETIC MIRROR FIELD. Hopfgarten, N.; Johansson, R. B.; Nilsson, B. H.; Persson, H. (Kungliga Tekniska Hoegskolan, Stockholm). pp 88 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

A Penning discharge in a strongly inhomogeneous magnetic mirror field led to an ion temperature of 1 to 3×10^6 K, a large-scale electric field parallel to a collision-free shock or sheath-like structure, and the acceleration of ions by a laminar wave (possibly a stage in the collective transfer of directed energy from electrons to ions). The role of the convergence of the magnetic field is briefly discussed. (France)

21315 NONADIABATIC MOTION OF A CHARGED PARTICLE IN A SPATIALLY AND SINUSOIDALLY MODULATED MAGNETIC FIELD. Dunnett, D. A.; Jones, G. A. (Univ. of Liverpool). pp 99 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

The motion of a charged particle in a spatially and sinusoidally modulated magnetic field is studied. In a resonant situation the magnetic moment is no longer invariant and its variation is contrasted with that found previously where a step function modulation was examined. A complex phase space structure of closed curves is found with the possible appearance of amplitude instability. Reference is made to attempts at predicting this phenomenon and to the formulation of an alternative invariant of the motion. (France)

21316 EXPANSION OF A PLASMA ALONG A WEAKLY CORRUGATED MAGNETIC FIELD. Mirnov, V. V.; Ryutov, D. D. (Inst. of Nuclear Physics, Novosibirsk, USSR). pp 100 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

The longitudinal motion of a plasma in a weakly corrugated magnetic field with a corrugation period much smaller than the mean free path is considered. It is shown, that in general, corrugation results in a considerable decrease in the plasma expansion velocity. (France)

21317 SHEATH FORMATION IN THE CENTRE OF THE POLYTRON. Kilkenny, J. D. (Imperial Coll. of Science and Tech., London). pp 101 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

A result of a self-consistent single particle simulation of the polytron is that a potential sheath forms across the ring cusp. Experimentally, a sheath is observed photographically and a thickness inferred from current measurements and laser scattering. Also it is shown that the Hall acceleration obeys $mdV/dt = eE$. (France)

21318 PLEIADE ACCELERATOR EXPERIMENT. Geller, R.; Hess, W. R.; Hesse M.; Jacquot, B.; Jacquot, C. (CEN, Grenoble, France). pp 123 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

Recent optical measurement confirm that ion currents (j_i approximately 20 mA cm^{-2}) with a broad ion energy distribution around 1.2 keV are obtained in routine operation. The ion acceleration is due to an $E_{||}$ field, which was identified and measured for the first time. (France)

21319 INFLUENCE OF THE TRAPPED PARTICLE INSTABILITY ON THE ELECTRON DISTRIBUTION FUNCTION. Barbian, E. P.; Brownell, J. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam). pp 134 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

The distortion of an originally Maxwellian electron velocity distribution appears to be correlated with the trapped particle sideband instability. (France)

21320 FORMATION OF THE NEUTRAL CURRENT SHEET IN PLASMA NEAR THE ZERO LINE OF MAGNETIC FIELD. Syrovatskii, S. I.; Fradk, A. G.; Khodshaev, A. Z. (Inst. of Physics, Moscow). pp 150 of Fifth European Conference on

Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

It was shown experimentally that a neutral current sheet occurs as a result of the motion of a plasma in a magnetic field with a zero (neutral) line. (France)

21321 DYNAMICS OF STRONGLY NONLINEAR BEAM–PLASMA INTERACTION. . Jungwirth, K.; Piffl, V.; Ullschmied, J. (Inst. of Plasma Physics, Prague). pp 154 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

Agreement is observed between measured and calculated distribution functions, basic wave amplitude (NWA) profiles, and satellite frequencies for a strong wave-governed stage. After the first maximum of the BWA satellites, which have amplitudes comparable to that of the basic wave but have lower frequencies, an over-relaxation of the beam is observed. (France)

21322 QUASILINEAR AND NONLINEAR BEAM-PLASMA EXPERIMENTS. Roberson, C. W.; Gentle, K. W. (Univ. of Texas, Austin). pp 156 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

The nonlinear evolution of the wave spectrum and electron velocity distribution of a weak beam–plasma interaction in the limiting cases of a large and small beam-velocity spread are measured and compared with theory. (France)

21323 ONE- AND THREE-DIMENSIONAL VELOCITY DIFFUSION IN AN ELECTRON BEAM–PLASMA INTERACTION. Wong, A. Y.; Gresillon, D.; Mills, P. (Ecole Polytechnique, Paris). pp 157 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

A collisionless plasma to which an axial B field can be applied without appreciably changing the parameters was used to investigate interactions with a weak electron beam. The plateau shape of the distribution function was shown to be much more persistent in the presence of an axial B field than in the absence of such a field. (France)

21324 ELECTROMAGNETIC-FIELD–CHARGED-PARTICLE INTERACTION IN PLASMAS. Iorcachescu, V. V. (Inst. of Atomic Physics, Bucharest). pp 163 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

Interactions between charged particles and electromagnetic fields were studied. Interactions in cold drifting plasmas were investigated in view of studying problems concerning waves and instabilities in plasmas, properties of plasmas in very-high-frequency fields, particle-system–electromagnetic field energy change dynamics, plasma diagnostics, and thermonuclear plasma confinement. (France)

Kinetics (Experimental)

21325 DEVELOPMENT AND PROPERTIES OF THE HALO IN PINCH PLASMAS. Freund, J. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Z. Phys.; 258: No. 2, 108-125(1973). (In German).

In pinch discharges a second plasma regime called halo outside the central plasma column was observed. This surrounding plasma was investigated in the experiments with the 5.4-m-long compression coil in the ISAR I linear theta pinch because there it appears highly pronounced. The development of the discharge was observed side-on (stereoscopic) with image converters and a streak camera. It appears possible to resolve the space-time behavior of the plasma, especially in the dynamic phase of the discharge where the halo shows a filament like structure, by using high-speed color reversal film (streak camera). Furthermore, the smear pictures show that after 6 to 8 μsec the halo region is frozen into the external magnetic field, that is from this time the halo is characterized by a high electrical conductivity. The boundary layer of the halo follows a magnetic flux tube. The parameters of the halo, such as electron density n_e($<10^{15}$ cm^{-3}), atomic temperature T_a, and ion temperature T_i(<15 eV), were determined spectroscopically as a function of time and location from the broadening of the deuterium Balmer lines. The absolutely measured line intensities do not allow direct calculation of the electron temperature since the excited levels of the investigated Balmer lines are mainly populated from the ground level. By numerical solution of a system of rate equations describing the change of the levels a region for the electron temperatures $5 < T_e < 10$ eV can be specified. Different mechanisms, such as photoionization, ionization by electron impact in a time varying magnetic field, ionizing collisions of high velocity neutral atoms with neutral gas at rest, transport processes in the plasma across the magnetic field, instabilities which may cause the development of the halo, are discussed by means of the experimental results. It is concluded that the halo region is caused by flute instabilities. (auth)

21326 STUDY OF X-RAY RADIATION IN THE TOKAMAK-4 INSTALLATION. Vershkov, V. A.; Mirnov, S. V. (Inst. of Atomic Energy, Moscow). pp 1 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

Soft x-ray emission from the Tokamak-4 device was studied using scintillation techniques. The emission takes place in macroscopically stable discharges near the current maximum and disappears with the occurrence of a spike instability. (France)

21327 HIGH-ENERGY ELECTRONS IN ST TOKAMAK DISCHARGES. Van Goeler, S.; Stodiek, W. (Princeton Univ., NJ). pp 2 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

Experiments described suggest that the high-energy electron component observed in ST Tokamak discharges is produced by classical electron runaway. (France)

21328 TOROIDAL PLASMA FAST RADIAL DISPLACEMENT BY TRANSVERSE MAGNETIC FIELD. Kaganski, M. G.; Ovsyannikov, V. A.; Tulpanov, S. S. (Physical Technical Inst., Leningrad). pp 7 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

Experiments performed in the Tuman-2 device showed that, in transverse magnetic fields, the toroidal plasma moves rapidly with the longitudinal current. Radial velocities up to 2×10^5 cm/sec were measured. When the plasma column comes into contact with the conducting diaphragm, it is slowed down, because of a large transverse current short-circuited across the diaphragm. (France)

21329 RESULTS FROM THE TOROIDAL Z-PINCH EXPERIMENT ZT-1. Burkhardt, L. C.; Di Marco, J. N.; Forman, P. R.; (and others) (Los Alamos Scientific Lab., NM). pp 45 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

The toroidal Z-pinch experiment, ZT-1, has produced a deuterium plasma of approximately 10^{15} cm^3, a plasma temperature ($T_e + T_i$) of 1 to 4 keV, and a β_θ of 0.4, calculated from magnetic-probe data. The pinch has gross stability, but is unstable on local modes. Magnetic-field programming will be used to stabilize these modes. (France)

21330 ACCELERATION MECHANISM OF CHARGED PARTICLES IN A DYNAMIC Z PINCH. Kvartskhava, I. F.; Matveev, Y. V.; Reshetnyak, N. G. (Inst. of Physics and Tech., Sukhumi, USSR). pp 46 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

Experimental data relevant to the possibility of accelerating particles in an induction field excited on decreasing the pinch magnetic flux by switching off the external circuit are presented. (France)

21331 EXPERIMENTAL INVESTIGATION OF COLLECTIVE PROCESSES IN A THETA PINCH. El-Khalafawy, T. A.; Bourham, M. A.; El-Behay, A. Z.; (and others) (Atomic Energy Commission, Cairo). pp 48 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804–.

The investigation of collective processes in a theta pinch, with

and without an azimuthal magnetic field B_0, is discussed. It is demonstrated that at $B_0 = 0$, the plasma is exposed to unstable hydrodynamic-type oscillations with ω approximately $(\omega_{ce}\omega_{ci})^{1/2}$. When B_0 is not equal to 0, relativistic electrons exist in the plasma and the plasma turbulence is determined by collisionless relaxation of the beam. (France)

21332 THETA-PINCH EXPERIMENTS WITH HIGH-FREQUENCY EQUILIBRIUM FIELDS IN A TOROIDAL SECTOR. Hofmann, F.; Jones, I. R.; Hirt, P.; Simik, A. (Centre de Recherches en Physique des Plasmas, Lausanne, Switzerland). pp 49 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Theta-pinch experiments in a toroidal sector with a high-frequency axial current are described. In contrast with previous experiments, an axial current flowing on the surface of the dense plasma column was observed on installing limiters at the ends of the discharge tube. (France)

21333 MEASUREMENTS OF TEMPERATURES AND DENSITIES IN A CONTINUOUS FLOW PINCH. Prinn, A. E.; Ricketts, B. W.; Tsagas, N.; Newton, A. A. (Univ. of Liverpool). pp 54 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Electron temperature and densities of a continuous flow pinch formed in a coaxial plasma gun were measured during the 40-μsec stable lifetime of the pinch. Temperature of 50,000°K and densities of $3 \times 10^{17}/cm^3$ were found, and these values are compared with those derived from a one-dimensional model of the compression process. (France)

21334 TOROIDAL HIGH-BETA PLASMA IN A PERIODIC CAULKED CUSP FIELD. Uchida, T.; Sato, K.; Akiyama, R.; (and others) (Nagoya Univ., Japan). pp 55 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

A periodic caulked-cusp torus field effectively suppresses toroidal drift in high-beta plasmas as well as producing stabilization. These effects are studied for a toroidal theta-pinch machine equipped with a large number of current-induced rings located inside the discharge tube. (France)

21335 ABSORPTION OF PICOSECOND LIGHT PULSES BY SOLID TARGETS. Andrews, A. J.; Hall, T. A.; Hughes, T. P. (Univ. of Essex, Eng.). pp 62 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Results are given showing the variation of reflectivity of polished solid targets as a function of the intensity of single mode-locked pulses (<10 psec) from a Nd^{3+} glass laser system. Enhanced absorption occurs above a threshold of 5×10^{13} W/cm^2, independent of the state of polarization of the incident pulse. Under these conditions the two-stream instability might be responsible for the increased absorption but a simpler alternative explanation is favored. (France)

21336 EXPERIMENTAL STUDY OF CUMULATIVE PLASMA PHENOMENA. Gribkov, V. A.; Korzhavin, V. M.; Krokhin, O. N.; (and others) (Inst. of Physics, Moscow). pp 64 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Gas-dynamic properties and x-ray and neutron radiation of plasma focus and collapse of laser plasma are investigated experimentally. The gas-dynamic and magnetic-field cumulations are compsred. (France)

21337 NEW EXPERIMENTAL RESULTS ON THE PLASMA FOCUS. Bernard, A.; Coudeville, A.; Durantet, J.; (and others) (CEA, Villeneuve-Saint-Georges, France). pp 65 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

When the focus machine is operated at high-enough filling pressures the neutron fluences are equal in three directions and the energy spectrum on the axis is centered at 2.5 ± 0.1 MeV. Other measurements of the electron density and deuteron temperature are being done by holographic interferometry and Thomson scattering. (France)

21338 NEUTRON-EMITTING AREA OF A PLASMA FOCUS. Conrads, H.; Cloth, F. (Kernforschungsanlage, Juelich, Ger.). pp 67 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The spectra and emission time of neutrons were observed over a distance of 126 cm along the axis of symmetry of a plasma focus for (d,d) and (d,^{7}Li) reactions. The radial neutron emission was close to the anode less than 2 cm and in a distance downstream of 10 cm and 20 cm close to 5 cm and 10 cm, respectively. (France)

21339 MEASUREMENT OF THE FARADAY ROTATION WITHIN THE PLASMA OF A GAS DISCHARGE OF THE PLASMA-FOCUS TYPE. Notkin, G. E.; Filippov, N. V.; Shcheglov, D. A. (Inst. of Atomic Energy, Moscow). pp 69 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

An apparatus for measuring the Faraday rotation of a ruby laser beam passing through a plasma focus device is described. Preliminary experimental results are reported. The observed values of rotation are compared with the calculations made using an MHD numerical code. (France)

21340 INTENSITY ANISOTROPY AND FINE STRUCTURE IN THE X-RAY IMAGES OF THE DENSE PLASMA FOCUS. Bostick, W. H.; Nardi, V.; Prior, W. J.; Rodriguez-Trelles, F. (Stevens Inst. of Tech., Hoboken, NJ). pp 70 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The structure of the x-ray source in each single discharge by a plasma coaxial accelerator is resolved as a multiplicity of very localized sources (~0.1 mm linear dimensions) inside a broader source of softer x rays. Each localized source is radiating anisotropically with a greater intensity in the direction orthogonal to the electrode axis (photon energies ~2 keV). (France)

21341 PLASMA ENCOUNTER AND COMPRESSION EXPERIMENTS. Kishimoto, H.; Goto, S.; Ito, H. (Osaka Univ.). pp 103 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

An experiment in which two plasma blobs ejected from theta-pinch guns are made to collide with one another in a long uniform magnetic field is presented. A 25- to 30-kg magnetic field having a 1.2-μsec rise time was impressed on a thermalized deuterium plasma (having an ion density of 2×10^{14} ions cm^{-3}). The maximum electron temperature (5 keV) was estimated from the x rays emitted from the axially compressed plasma. A total neutron yield of about 3×10^5 was measured. (France)

21342 MICROWAVE RADIATION FROM A TURBULENTLY HEATED TOROIDAL PLASMA. Hamberger, S. M.; Sharp, L. E.; Jancarik, J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). pp 146 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Time resolved measurements of the frequency spectrum of suprathermal microwave (8 to 40 GHz) emission from a turbulent plasma column are described. (France)

21343 ION HEATING AND RADIATION OF A TURBULENTLY HEATED PLASMA. Piekaar, H. W.; de Kluiver, H.; Schrijver, H.; (and others) (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas, Netherlands). pp 147 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Measurements on the energy content, the microwave radiation, and the $H_{(\beta)}$ emission of a turbulently heated plasma are reported. The characteristic frequencies of the ion-acoustic and the electron-ion two-stream instability are observed. $H_{(\beta)}$ satellites are reported in the presence of turbulent electric fields. (France)

21344 EXPERIMENTS ON PRODUCTION OF RELATIVISTIC ELECTRON BEAM IN A LINEAR DISCHARGE. Avrorov, A. P.; Boyarintsev, E. L.; Kornilov, V. A.; Ponomarenko, A. G.; Rogozin, A. I. (Inst. of Nuclear Physics, Novosibirsk, USSR). pp 160 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Under defined initial conditions, an increase in turbulence is observed in a linear discharge resulting in the localization of the voltage drop across the discharge gap and also the formation of a beam of accelerated electrons. Experiments were performed with a 10- to 50-kV arrangement, a potential difference up to 0.5 MV being applied across a narrow discharge gap initially filled with cold plasma, in view of producing a relativistic electron beam. (France)

21345 EXPERIMENTS ON THE INVESTIGATION OF HIGH-CURRENT RELATIVISTIC-ELECTRON-BEAM INTERACTION WITH PLASMA IN A MAGNETIC FIELD. Koydan, V. S.; Lagunov, V. M.; Lukyanov, V. N.; Mekler, K. I.; Sobolev, O. P. (Inst. of Nuclear Physics, Novosibirsk, USSR). pp 161 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The energy losses experienced by a relativistic electron beam traversing a plasma in a magnetic field were studied. The experimental aspects of the investigation are described. (France)

Kinetics (Theoretical)

Refer also to abstracts 21387 and 21400.

21346 (ORNL-TM-4103) POLARIZATION OF FREE-FREE BREMSSTRAHLUNG FROM MAGNETICALLY-CONFINED PLASMAS. England, A. C. (Oak Ridge National Lab., Tenn.). Feb 1973. Contract W-7405-eng-26. 14p. Dep. NTIS.

The polarization of bremsstrahlung from electron-ion collisions is calculated for magnetically confined electrons in the Born approximation. The polarization at high temperature is found to be of opposite sign to the low-temperature result and of smaller magnitude. (auth)

21347 DIFFUSION-DRIVEN CURRENT IN A TOROIDAL RESISTIVE PLASMA. Stringer, T. E. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Plasma Phys.; 14: No. 12, 1063-1072 (Dec 1972).

General expressions for the diffusion-driven current flow parallel to the magnetic field are derived for a quasi-equilibrium toroidal plasma. These expressions are used to evaluate the current in a resistive plasma, including the effect of finite electron thermal conductivity. The current and radial diffusion satisfy the Onsager relations in those conditions where the ordering retains all related terms. (UK)

21348 OLVER'S ALGORITHM TO EVALUATE CERTAIN DEFINITE INTEGRALS OF PLASMA PHYSICS INVOLVING CHEBYSHEV POLYNOMIALS. Sadowski, W. L.; Lozier, D. W. (National Bureau of Standards, Washington, DC). J. Comput. Phys.; 10: No. 3, 607-613 (Dec 1972).

Three methods were used to evaluate certain integrals involving Chebyshev polynomials. The paper shows that a seemingly simple computational problem may be intractable unless a suitable algorithm is chosen. In this case the simplest conceivable method fails badly and a more sophisticated method has severe limitations on the significance that can be obtained. The third method is based on a three-term inhomogeneous recursion. Asymptotic analysis shows that there is a rapidly increasing solution and a rapidly decreasing solution, while the desired solution decreases slowly. Therefore, neither forward nor backward recurrence is stable for this method. The powerful algorithm developed by Olver (J. Research NBS, B71: 111(1967)) is used to obtain the solution. (MOW)

21349 EVALUATION OF SOME NUMERICAL METHODS FOR SOLVING ABEL'S INTEGRAL EQUATION. Kulagin, I. D.; Sorokin, L. M.; Dubrovskaya, E. A. Opt. Spectrosc. (USSR) (Engl. Transl.); 32: No. 5, 459-462 (May 1972).

Translated from Opt. Spektrosk.; 32: No. 5, 865-870 (May 1972).

Some numerical methods for solving Abel's integral equation and their sensitivity to random errors were evaluated. It was shown how the accuracy of the calculation is affected by the number of zones and by the chosen profile of the intensity distribution of a line. Calculation by the Pearse method gives a qualitatively incorrect distribution of the local coefficient of emission close to the axis of the source. The Bockasten method has high accuracy but is very sensitive to the introduced error. The advantage of the Nester and Olsen method lies in its fair accuracy and low sensitivity to random errors. Thus, it can be recommended for numerical solution of Abel's integral equation. (auth)

21350 VARIATIONAL ALGORITHMS FOR NUMERICAL SIMULATION OF COLLISIONLESS PLASMA WITH POINT PARTICLES INCLUDING ELECTROMAGNETIC INTERACTIONS. Lewis, H. R. (Culham Lab., Abingdon, Eng.). J. Comput. Phys.; 10: No. 3, 400-419 (Dec 1972).

Energy- and charge-conserving algorithms for numerical simulation of collisionless plasma with point particles, including electromagnetic interactions, are derived from Hamilton's variational principle. The equations are put in a form suitable for advancing the electromagnetic potentials with a time-centered leapfrog difference scheme. An example is presented for a cartesian geometry. (auth)

21351 INFLUENCE OF RANDOM ERRORS IN CALCULATION OF THE EMISSION COEFFICIENT OF PLASMA. Litvinova, N. N. Vestn. Leningrad. Univ., No. 16, Fiz., Khim.; No. 3, 37-45 (Aug 1972). (In Russian).

Algorithms for optimal estimation of parameters characterizing the emission coefficient of plasma are proposed on the basis of statistical theory. Noise stability of the widely used calculation methods and new optimal methods suggested in the paper are compared. (auth)

21352 BREMSSTRAHLUNG RADIATION FROM THE WEAKLY IONIZED LABORATORY PLASMA. Shukla, P. K.; Gwal, A. K.; Vohra, K.; Misra, K. D. (Banaras Hindu Univ., India). Indian J. Pure Appl. Phys.; 10: No. 7, 508-511 (Jul 1972).

The Boltzmann transport equation for weakly ionized plasma is linearized and solved for the first- and second-order velocity distribution functions. Considering the binary collisions as a source of electromagnetic wave emission, expressions for the absorption coefficient, the emission coefficient and the total radiated power are derived. The effect of first- and second-order perturbations in the velocity distribution function on the total electromagnetic power in the case of a laboratory plasma is studied. (auth)

21353 LAGRANGIAN DESCRIPTION OF WARM PLASMAS. Kim, H. Stanford, CA; Stanford Univ. (1972). 155p. University Microfilms Order No. 72-30,648.

Thesis (Ph.D).

The main aims of this research are to extend the averaged Lagrangian method of describing small-signal wave propagation and nonlinear wave interaction, developed by earlier workers for cold plasmas, to the more general conditions of warm collisionless plasmas, and to demonstrate particularly the effectiveness of the method in analyzing wave-wave interactions. The theory is developed for both the microscopic description and the hydrodynamic approximation to plasma behavior. First, a microscopic Lagrangian is formulated rigorously, and expanded in terms of perturbations about equilibrium. Two methods are then described for deriving a hydrodynamic Lagrangian. The first of these is to obtain the Lagrangian for the second moment equation (the momentum equation) and Maxwell's equations by velocity integration of the exact microscopic Lagrangian. Other moment equations must then be employed as subsidiary conditions. The expansion of this Lagrangian is carried out for three illustrative cases: one-dimensional compression parallel to the static magnetic field, two-dimensional compression perpendicular to it, and three-dimensional compression. In the second method, the expanded hydrodynamic Lagrangian is obtained directly from the expanded microscopic Lagrangian. In contrast to the first method, no subsidiary conditions are required, and certain mathematical difficulties are avoided. For the analysis of small-signal propagation and three-wave interactions, the contributions to the expanded Lagrangian second and third order in perturbation are specialized to a warm, infinite, weakly inhomogeneous plasma in a static magnetic field, and are averaged over space and time so as to remove rapidly varying terms. The first-order Euler-Lagrange equations obtained by application of Hamilton's principle are the equation of motion, Maxwell's equations, and the equation of conservation of action. The second-order Euler-Lagrange equations are the coupled-mode and the action-transfer equations. (TSS) (Diss. Abstr. Int., B)

21354 PLASMA DYNAMICS IN TWO DIMENSIONS. Taylor, J. B. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). pp 11 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

A kinetic theory for two-dimensional guiding-center plasma is developed and shown to have many unconventional features. (France)

21355 GUIDING-CENTER PARTICLE CODE FOR AXISYMMETRIC TOROIDAL EQUILIBRIA, WITH SELF-CONSISTENT ELECTRIC FIELDS. Fielding, P. J.; Laing, E. W. (Glasgow Univ.). pp 37 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

A method is presented for computing steady-state solutions to the Vlasov–Poisson system of equations in the guiding-center approximation, for axisymmetric toroidal plasmas in magnetic fields with closed flux surfaces. Account is taken of ion scrape-off at the limiter, this being the mechanism via which an electrostatic field establishes itself in the plasma. (France)

21356 LINEAR AND NONLINEAR PERTURBATION THEORY OF RESISTIVE PINCH. Callebaut, D. K.; Krueger, J. G. (Rijksuniversiteit, Ghent). pp 42 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The MHD theory applicable to a relatively simple pinch is derived up to the second-order perturbation amplitude, axially symmetric perturbations including anisotropic resistance being considered. The introduction of resistivity alters somewhat the region in which the linear theory is applicable. (France)

21357 COMPUTER STUDY OF THE DYNAMIC PHASE OF A BELT PINCH EXPERIMENT. Gruber, R.; Hofmann, F. (Centre de Recherches en Physique des Plasmas, Lausanne, Switzerland). pp 50 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The dynamic phase of a belt-pinch experiment was simulated on the computer, using a three-fluid MHD code. Density, temperature, magnetic field, and current distributions were computed. The effect of the poloidal magnetic field on the radial motion of the plasma was investigated. (France)

21358 PARTICLE MOTION NEAR ELECTRON CYCLOTRON RESONANCE. Schep, T. J. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas, Netherlands). pp 122 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The relativistic motion of an electron under the influence of a right-circularly polarized wave propagating along a homogeneous magnetic field is considered. The particle trajectory is given in a frame that rotates with the Doppler-shifted frequency, the constants of motion being utilized. (France)

21359 CLASSIFICATION AND STABILITY OF THE BGK STATIONARY STATES FOR A DOUBLE WATER-BAG MODEL. Finzi, U.; Holec, J.; Doremus, J. P. (CEN, Grenoble, France). pp 138 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The conditions necessary for the existence of periodic and aperiodic nonlinear stationary states in a double water-bag model are given. A method of analyzing the stability, already used in the analogue stellar-dynamics problem, is applied to the aperiodic problem. (France)

21360 ANOMALOUS RESISTIVITY. Wesson, J.; Sykes, A. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). pp 170 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

A two-dimensional simulation was used to elucidate the properties of the anomalous resistivity arising through current-driven instabilities. It is found that the instability produces a stabilizing modification of the electron distribution function, which in turn leads to a decay of the resistivity. (France)

Production

21361 (NP-19656) LASER PLASMA INJECTION INTO A STELLARATOR. Preprint No. 112. Andryukhina, E. D.; Bloch, M. A.; Voronov, G. S.; Fedyanin, O. I.; Kholnov, Yu. V.; Shpigel, I. S. (Akademiya Nauk SSSR, Moscow. Fizicheskii Institut). 1972. 14p. (In Russian). Dep. NTIS (U. S. Sales Only).

The properties of a laser-produced plasma trapped in the l = 2 TOR-1 stellarator are described. A considerable range of plasma density and ion temperature was obtained by the variation of laser energies and the confining magnetic field strength. Plasma density determination was made by a microwave interferometer; the density varies in the range of 10^{10} to 10^{12} cm^{-3}. (MOW)

21362 INFLUENCE OF A MAGNETIC FIELD ON A PLASMA PRODUCED BY LASER RADIATION IN A SOLID TARGET. Schwarz, H. (Rensselaer Polytechnic Inst., Hartford). Kvantovaya Elektron. (Moscow); No. 5, 102-105(1971). (In Russian).

Experiments show that the thermal ion energy of a plasma produced in a solid target by an impingent ruby laser beam increases with the magnetic field when the plasma beam is directed along an imposed steady magnetic field. A law is obtained to relate the thermal ion energy to the magnetic field during this interaction. Theoretical considerations are given to substantiate this observation. (IAA)

21363 ENERGY ABSORPTION BY A RADIOISOTOPE-PRODUCED PLASMA. August, H. (to North American Aviation, Inc.). U. S. Patent 3,713,157. 23 Jan 1973. Filed date 31 Jul 1964. 16p.

This invention relates to an arrangement for producing an ionized plasma adjacent to a surface. In particular, it relates to providing a body with a coating capable of injecting kinetic energy into an adjacent gaseous medium, thereby reducing the frictional drag of the body when traveling through such a medium. Also, it is capable of producing an ionized plasma sheath that will absorb or attenuate the transmission of electromagnetic and longitudinal-type energy. (Official Gazette)

21364 PLASMA PRODUCTION BY LASER. Mulser, P.; Sigel, R.; Witkowski, S. (Max-Planck-Institute fuer Plasmaphysik, Garching, Ger.). Phys. Rep.; 6: No. 3, 187-239(Jan 1973).

A review of high-density, high-temperature plasma production with pulse lasers is presented. In view of possible applications to thermonuclear fusion the discussion is limited to plasma generation from solid targets of low atomic number Z, with particular emphasis on solid deuterium. (116 references) (auth)

21365 ENERGY CRISIS. Part 1. Lasers and Fusion. Opt. Spectra; 7: No. 2, 27-30; 32-34; 40-41(Feb 1973).

A historical review of laser fusion research is outlined. The areas of special promise for laser fusion, namely, inertial and magnetic confinement, are discussed. US research progress on laser fusion is described. (MOW)

21366 EXPERIMENTAL STUDIES ON SOLID-DEUTERIUM NANOSECOND POWERFUL PRODUCED PLASMA. Saleres, A.; Cognard, D.; Floux, F. (CEA, Villeneuve-Saint-Georges, France). pp 59 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Short rise time laser pulses were focused onto solid deuterium targets. The reflected energy and the nuclear fusion taking place were studied as a function of the pulse duration for two apertures of the focusing lens: f/1 and f/1.75. Interferometry (with green light) was used to study the plasma, the incident radiation being made to traverse the expanding lower density layers. An electron density of $5 \times 10^{19}/cm^3$ was measured. (France)

21367 X-RAY EMISSION IN LASER-PRODUCED PLASMAS. Colombant, D.; Tonon, G. F. (CEA, Villeneuve-Saint Georges, France). pp 60 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Numerical results for heavy-ion Nd-laser-produced plasmas are presented. The conversion ratio: radiation power/incident laser power is computed. When an emission length L is introduced into the hydrodynamic model, the results obtained are in good agreement with the experimental results, conversion ratios in excess of 10% being obtained. (France)

21368 EXPANSION OF A LASER-PRODUCED PLASMA. Rumsby, P. T.; Beaulieu, J. (United Kingdom Atomic Energy

Authority, Abingdon, Eng.). pp 61 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The adiabatic expansion and cooling of a laser-produced plasma was investigated experimentally. The density was found to fall exactly as $n = kt^{-3}$. Temperature measurements at large distances are consistent with a $T = kt^{-2}$ dependence at early times followed by a slower decay at late times. (France)

21369 INVESTIGATION OF SELF-GENERATED MAGNETIC FIELDS IN LASER-PRODUCED PLASMAS. Schwirzke, F.; McKee, L. L. (Naval Postgraduate School, Monterey, CA). pp 63 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The dynamics of a laser-produced plasma and the dependence of the self-generated magnetic fields on position, time, laser power density, and ambient background pressure was investigated. Electrons and ions can not separate when the laser-produced plasma expands into a high vacuum. With a background gas the laser heated electrons can stream freely out of the laser-heated region, through the photo-ionized background plasma and considerably higher magnetic fields are generated. (France)

21370 LASER-PLASMA INJECTION INTO THE STELLARATOR. Andryukhina, E. D.; Bloch, M. A.; Voronov, G. S.; (and others) (Inst. of Physics, Moscow). pp 81 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The properties of laser-produced plasmas trapped in a stellarator are discussed. A considerable range of plasma densities and ion temperatures was obtained by varying the laser energy and the strength of the confining magnetic field. The dependence of the ion temperature on the laser energy may be due to resonance exchange between high energy and cold Li atoms. (France)

Stability

Refer also to abstracts 21284 and 21319.

21371 (IPPJ-121) MAGNETOHYDRODYNAMIC AND TEARING INSTABILITIES OF A CURRENT-CARRYING PLASMA IN A TOKAMAK-TYPE DEVICE. Amano, T.; Wakatani, M.; Watanabe, M. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Mar 1972. 28p.

The stability of a current-carrying plasma in a strong longitudinal magnetic field, such as in tokamak-type devices, against the MHD and tearing instability is investigated. The growth rates of the MHD instability are computed numerically as eigenvalues of the equation of motion for several current distributions. The influence of the position of the conducting shell on the stability is also investigated. (auth)

21372 NONLINEAR STABILIZATION OF SYNCHROTRON INSTABILITY. Kaplan, S. A.; Tsytovich, V. N. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 15: No. 10, 1464-1468(1972). (In Russian).

It is shown that the synchrotron instability on Langmuir waves is stabilized by the nonlinear pumping on thermal ions and the synchrotron instability on electromagnetic waves is stabilized by decay processes. The quasi-linear relaxation of synchrotron instability is inessential. The energy density of electromagnetic radiation driven by synchrotron instability may reach the greater value than the energy density of plasma waves despite the larger increment of plasmon driving. (auth)

21373 COLLISIONAL CYCLOTRON INSTABILITY IN RAMSAUER EFFECT IONIZED GASES. Oddou, C. (Univ., Paris). J. Phys. (Paris); 33: No. 10, 861-876(Oct 1972). (In French).

Anomalous cyclotron radiation due to a collisional instability in an ionized Ramsauer gas was studied experimentally in different rare gases discharges. Under specific conditions, strong low frequency oscillations in the plasma potential are accompanied by synchronous microwave frequency radiation pulses. The emission spectrum shows a sharp and intense peak in vicinity of the electron cyclotron frequency. Calculations based on the theory of fluctuations for dense plasmas are in agreement with experimental data. A model is presented for which the building up of an inverted population distribution (necessary at the instability) results from the presence of the electric field on an ionization wave. In this case, it is theoretically demonstrated and experimentally verified that the absolutely unstable medium behaves as an oscillator. (FR)

21374 ION CYCLOTRON INSTABILITIES IN HIGH-β PLASMAS. Cordey, J. G.; Farr, W. M. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Plasma Phys.; 14: No. 12, 1109-1116(Dec 1972).

The complete dispersion equation (including all the electromagnetic terms) for flute-like ion cyclotron instabilities in a high-beta plasma is solved using both numerical and analytic methods. A new type of ion cyclotron instability is found which is caused by the coupling of an electrostatic ion cyclotron wave with an electromagnetic ion cyclotron wave. The effect of magnetic field inhomogeneity is found to reduce the growth rate of this instability but does not stabilize it. (auth)

21375 LOW-FREQUENCY INSTABILITIES IN PLASMA WITH MAGNETIC SHEAR. Gladd, N. T. Austin, TX; Univ. of Texas (1972). 99p. University Microfilms Order No. 73 440. Thesis (Ph.D).

The presence of magnetic shear in a plasma is known to have a stabilizing effect on some plasma waves. Previous studies of shear stabilization have shown that plasma models must be treated nonlocally to adequately describe the effects of shear. The development of spatial eigenmode equations for collisionless drift waves and trapped-particle modes is reviewed and perturbation and numerical techniques are applied to obtain their solutions. After briefly reviewing some previous analytical work on shear stabilization, the critical shear is computed for density-gradient drift waves, finding that more shear is required than previously predicted. Stability conditions are calculated for drift-wave models with electron current and temperature gradients and also a simple model is derived for the electromagnetic coupling of drift waves with high-frequency waves. Dissipative trapped-ion modes and trapped-particle flute modes are calculated using both simple nonlocal models and a model resembling a large tokamak. When the shear-induced effects of untrapped-ion resonances are neglected, the eigenvalues of the radial modes closely approximate those obtained from local theory. When the untrapped-ion resonances, which give rise to ion Landau damping, are included, the eigenmodes tend to form nodes at the rational flux surfaces where the resonances are strongest. Regimes previously found unstable remain so, but with lower growth rates and with the larger radial wave numbers and smaller azimuthal wave numbers dominating. (Diss. Abstr. Int., B)

21376 CLASS OF HELICALLY SYMMETRIC EQUILIBRIA. Correa, R.; Lortz, D. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 21 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Helically symmetric equilibria are described in terms of the vector field with cylindrical coordinates. Solutions representing stable configurations with continuous pressure profiles surrounded by vacuum are obtained. (France)

21377 STATIONARY TOROIDAL EQUILIBRIA AT FINITE BETA. Zehrfeld, H. P.; Green, B. J. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 22 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The effects of plasma flow on axially symmetric self-consistent equilibria in toroidal geometry were studied. In contrast to previous flow calculations, both flow and beta effects were taken into account. A quite general discussion of the existence and nature of the equilibrium is possible. Explicit results are presented. (France)

21378 TOKOMAK EQUILIBRIA WITH HIGH β POLOIDAL. Luc, H.; Maschke, E. K.; Touche, J. (CEN, Fontenay-aux-Roses, France). pp 23 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

A natural definition of β_{pol} is introduced that does not lead to ambiguities at high pressure. The possible occurrence of a separatrix and the MHD stability dependence on ballooning effects at high β_{pol} are discussed. (France)

21379 NUMERICAL STUDIES OF MHD EQUILIBRIUM AND STABILITY IN TOKAMAKS WITH NONCIRCULAR CROSS SECTION. Grelot, P.; Weisse, J. (CEN, Grenoble, France). pp 24 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The regions of equilibrium, stable with respect to Mercier's criterion, are determined numerically for a plasma confined in an axisymmetric configuration with arbitrary cross section. The computer codes take into account, without any restriction, the toroidal effects, the pitch angle introduced in the elliptical terms, and the amplitude and pitch angle of the third-order terms, thus allowing a generalization of previous results obtained for certain shell shapes by various authors. (France)

21380 KINK INSTABILITIES IN A CYLINDRICAL PLASMA WITH ELLIPTICAL CROSS-SECTION. Laval, G.; Pellat, R.; Soule, J. L. (CEN, Fontenay-aux-Roses, France). pp 25 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The conditions for stability of kink modes for a plasma with a large aspect ratio, an elliptical cross section, and a flat current profile are determined exactly. (France)

21381 EQUILIBRIUM AND STABILITY OF THE BELT PINCH. Herrnegger, F. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 26 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Exact axisymmetric toroidal equilibria are calculated. They depend on a single parameter the value of which is determined by β_φ at the magnetic axis, the torus radius, and the ratio of axial to radial extension of the plasma cross section. The equilibrium satisfies the necessary Mercier criterion for local stability. (France)

21382 STABILITY OF HELICALLY SYMMETRIC l = 2 AND l = 3 EQUILIBRIA. Rebhan, E. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 28 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

A sufficient stability criterion is applied to helical l = 2 and l = 3 equilibria in the neighborhood of the magnetic axis. While l = 2 configurations violate this criterion, l = 3 configurations are stable if a properly defined local β is small enough. Rough estimates for a nonlocal critical β yield approximately 10%. (France)

21383 TEARING INSTABILITY DUE TO THERMAL EFFECTS. Rebut, P. H.; Samain, A. (CEN, Fontenay-aux-Roses, France). pp 29 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Tearing-like perturbations in a magnetic configuration with shear may be driven unstable by thermal effects in the resonant sheet. (France)

21384 TEARING-MODE INSTABILITIES OF A ROTATING PLASMA WITH HALL EFFECT. Kaleck, A. (Kernforschungsanlage, Juelich, Ger.). pp 30 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The growth rates of the resistive tearing-mode instabilities of a rigid rotating, isothermal cylindrical plasma are calculated in an MHD model with Hall effect. If the two contributions from Hall effect and plasma rotation to the equilibrium, the radial electric field cancel out near the neutral layer $B_z^0 = 0$, the growth rates have a minimum. This minimum becomes smaller for higher values of the Hall parameter. (France)

21385 SURVEY OF STABILITY OF FORCE-FREE FIELDS WITH CONSTANT α. Krueger, J. G.; Callebaut, D. K. (Rijksuniversiteit, Ghent). pp 31 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Previous and new stability results are reviewed from a unified point of view. A general method for analyzing stability is presented, theorems and applications are given. A second-order variational expansion is used; the lowest possible value of α compatible with the geometry is shown to be stable for closed configurations. (France)

21386 NEUTRAL GAS EFFECTS ON PLASMA EQUILIBRIUM AND STABILITY. Lehnert, B. (Kungliga Tekniska Hoegskolan, Stockholm). pp 32 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

As a result of the permeability of Tokamak plasmas to neutral gas, the density gradient at the boundary steepens with increasing ion density (n). An instability occurs when $n > n_c \simeq 10^{20}\ m^{-3}$, which is independent of the toroidal magnetic field, and renders the plasma energy proportional to the square of the heating current. Neutral gas friction and viscosity effects stabilize impermeable plasmas. (France)

21387 NUMERICAL SIMULATION OF EQUILIBRIUM IN TOKAMAK DEVICES. Dnestrovskii, Y. N.; Kostomarov, D. P.; Popov, A. M. (Moscow State Univ.). pp 36 of Fifth European Conference on Controlled Fusion and Plasma Physics. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The problem of plasma equilibrium in toroidal systems is solved by the numerical integration of the magnetohydrodynamics equations. (France)

21388 APPLICATION OF THE VLASOV-FLUID MODEL TO HIGH-BETA STABILITY. Lewis, H. R.; Freidberg, J. P. (Los Alamos Scientific Lab., NM). pp 41 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

A formulation of the Vlasov-fluid model in a way suitable for numerical computation is described, and application to equilibria with axial and translational symmetry is discussed. (France)

21389 MODE COUPLING IN DYNAMIC STABILIZATION OF MHD MODES. Becker, G. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 52 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The m = 1 mode of the screw pinch was stabilized by hf B_z fields. Existing linearized theories fail to explain the measured dynamic force F, since mode coupling must be taken into account. A method of calculating F for coupling between the m = 0 and m = 1 modes is presented. (France)

21390 DYNAMIC STABILIZATION EXPERIMENTS ON A SCREW PINCH WITH STANDING WAVE MAGNETIC FIELDS. Becker, G.; Gruber, O.; Herold, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 53 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The growth of the helical m = 1 mode in a screw-pinch device is not reduced by the application of standing-wave magnetic fields, although the stabilizing conditions of the theory are satisfactorily fulfilled. The application of standing-wave magnetic fields to the theta pinch does not cause parametric excitation. (France)

21391 OBSERVATION OF ION LANDAU DAMPING OF THE DRIFT WAVE IN A SHEARED MAGNETIC FIELD. Dodo, T.; Nishida, Y.; Kuroda, T.; Horikoshi, G. (Nagoya Univ., Japan). pp 71 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The drift-wave stabilization by the magnetic shear is studied in a linear stellarator with l = 3 helical windings. The critical shear for the stabilization strongly depends on the ion temperature which is controlled arbitrarily. (France)

21392 SHEAR STABILIZATION OF DRIFT-DISSIPATIVE INSTABILITIES. Gregoire, M.; Rolland, P. (CEN, Grenoble, France). pp 72 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Studies carried out during recent years on stabilization by shear have not clearly defined the type of criteria that should be adopted: stability of the normal modes; spatial gain characteristics. In order to gain a better understanding of the shear stabilization of

dissipative drift instabilities, the maximum number of functions depending upon L_z, B_z, p and m is defined and compared with previous theoretical predictions. (France)

21393 PARTICLE BOUNCE EFFECT ON THE COLLISIONLESS DRIFT WAVE INSTABILITY. Brossier, P.; Deschamps, P.; Gravier, R.; Renaud, C. (CEN, Fontenay-aux-Roses, France). pp 73 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Previous measurements on the collisonless drift wave in the ODE device have emphasized the importance of end boundary conditions on the instability characteristics. A reflection of particles at each end of the experimental device was observed, and a new theory including this effect was derived. The observed parallel wave numbers can now be understood in terms of the modified theory. In addition, the previous discrepancy factor between observed and computed frequencies (or parallel wavelength) vanishes. (France)

21394 HIGH-FREQUENCY STABILIZATION OF DRIFT-WAVE INSTABILITIES. Dufayet, A.; Le Gardeur, R.; Moresco, M. Pelletier, G. (CEN, Grenoble, France). pp 74 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

A method of dynamic stabilization of drift-wave instabilities existing in the external density gradient of a cylindrical diffusion plasma column is described. A high-frequency longitudinal electric field induced inside the plasma by a longitudinal-type coil situated outside the plasma column was used. Experimental results, in agreement with the theoretical predictions, are given. (France)

21395 DYNAMIC STABILIZATION OF CURRENT DISCHARGE ON EXCITATION OF MAGNETO-ACOUSTIC RADIAL OSCILLATIONS OF PLASMA COLUMN. Roife, I. M.; Vasilevskii, M. A.; Seredenko, E. V. (Scientific Research Inst. of Electrophysical Apparatus, Leningrad). pp 75 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The enhanced stability of a modulated current discharge in a longitudinal magnetic field brought about by a dynamic stabilization mechanism was investigated. In the case of a lossless plasma model, the correlation between the modulation (ϵ) of the plasma radius for forced rf magnetoacoustic oscillations and the modulation (η) of the longitudinal magnetic field in the plasma can be expressed as $\eta = 2\epsilon$. The boundaries of the stability regions in the H plane are given. (France)

21396 STABILIZATION OF FLUTE INSTABILITY WITH ONE ELECTRODE FEEDBACK SYSTEM. Chuyanov, V. A. (Inst. of Atomic Energy, Moscow). pp 76 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

An influence of the finite number of stabilizing elements on the stabilization of the flute instability with the integrating feedback system was considered. The new mode suppressed by the electrical rotation of a plasma was found. (France)

21397 BEAM-DRIVEN PLASMA INSTABILITIES IN ASTRON-LIKE SYSTEMS. Striffler, C. D.; Kammash, T. (Univ. of Michigan, Ann Arbor). pp 97 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

A linear-stability analysis is performed on a model that simulates beam–plasma interactions in Astron and similar devices. It is shown that the strongest interaction occurs at beam harmonics near the plasma normal modes. Possible stabilizing effects of collisions between plasma and neutral particles and beam energy spread are examined. (France)

21398 DRIFT WAVES IN A HF PLASMA. Berger, E.; Raeuchle, E. (Univ., Stuttgart). pp 129 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Large amplitude drift waves were observed in an hf plasma. The plasma was produced in a resonant cavity located in a homogeneous magnetic field. The hf power is absorbed at the electron cyclotron resonance frequency. Drift instabilities were excited in the 60- to 130-kc range in a plasma having a complicated density structure. (France)

21399 MODEL FOR THE SATURATION OF STRONGLY NONLINEAR OSCILLATORY DISSIPATIVE INSTABILITIES. Cap, F. (Univ., Innsbruck). pp 130 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

A method to solve the strongly nonlinear weakly dissipative ordinary differential equations describing instabilities is given. (France)

21400 COMPUTER SIMULATION OF ELECTROMAGNETIC INSTABILITIES IN MAGNETIZED PLASMAS. Cuperman, S.; Salu, Y. (Tel Aviv Univ., Israel). pp 140 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The isothermalization of strongly anisothermal magnetized collisionless plasma by collective electromagnetic interactions $T_\perp/T_\parallel$ was investigated with the aid of particle-in-cell simulation methods. The isothermalization process is found to be strongly dependent on the initial ratio of the two temperatures involved, $T_\perp/T_\parallel$: the higher $T_\perp/T_\parallel$, the stronger the relaxation. For sufficiently large $T_\perp/T_\parallel$, values the isothermalization is complete. (France)

21401 CYCLOTRON INSTABILITY OF A PLASMA WITH SUPRATHERMAL ELECTRONS. Teichmann, J.; Van Andel, H.W.H. (Univ. of Montreal). pp 141 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Unstable electron cyclotron waves excited by the presence of isotropically distributed suprathermal electrons were studied. It was found that the plasma is unstable for certain regions of parameter space, and that inhomogeneities in the electron density may enhance the instability. (France)

21402 INSTABILITY OF LONGITUDINAL PLASMA OSCILLATIONS. Demchenko, V. V.; El-Naggar, I. I. (Atomic Energy Commission, Cairo). pp 142 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The instability of longitudinal hydrodynamic oscillations in an inhomogeneous plasma was investigated. It is shown that the nonuniform density leads to a specific parametric-type instability. Spatial dispersion and pinch nonlinearities also result in instabilities. (France)

21403 BEAM–PLASMA INSTABILITIES EXCITED BY THE ANOMALOUS DOPPLER EFFECT. Hopman, H. J.; Van Wakeren, J.H.A. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam). pp 151 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Measurements are presented that confirm the successive excitation by the beam of two instabilities at different positions in a plasma. The first instability, which is excited by the Cherenkov effect, gives rise to a plateau in the beam velocity distribution. The second instability, which is excited by the anomalous Doppler effect, gives rise to a second plateau in the beam velocity distribution function. (France)

21404 BEAM TRAPPING IN A BEAM–PLASMA SYSTEM. Hopman, H. J.; Jurgens, B.; Van Wakeren, J.H.A. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam). pp 152 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Measurements are presented that establish the existence of sideband instabilities in a beam–plasma system. The spatial growth of the sidebands is equal to that of the principal instability. Sidebands resulting from probe-excited waves are associated with a variation in the sideband frequency with distance. (France)

21405 DYNAMIC STABILIZATION OF PLASMAS BY MEANS OF A HIGH-FREQUENCY-MODULATED ELECTRON BEAM. Aghevli, R.; Rowe, J. E. (Univ. of Michigan, Ann Arbor). pp 153 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

A longitudinally inhomogeneous beam interacting with a surrounding plasma is investigated. For the one-dimensional case, stabilizing effects due to the beam inhomogeneity are observed for the convectively unstable modes over the entire frequency spectrum. A two-dimensional analysis indicates that no stabilizing effects are observed when B = 0. (France)

21406 LINEAR AND NONLINEAR PROPERTIES OF CONVECTIVE AND ABSOLUTE INSTABILITIES IN A BEAM–PLASMA SYSTEM. Bollinger, D.; Boyd, D.; Carr, W.; (and others) (Stevens Inst. of Hoboken, NJ). pp 155 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

In finite-temperature plasmas, the high-frequency instability appears in both absolute and convectively unstable modes. Both modes are studied and the transition between them controlled. The modes have strongly differing nonlinear properties. wo unstable waves can nonlinearly couple to produce many sidebands. (France)

21407 PLASMA COUNTER STREAMING IN A BEAM PRODUCED PLASMA. Hall, T. A. (Univ. of Essex, Eng.). pp 158 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

It is shown that the injection of a beam of charged particles to produce a plasma (by collisions with neutral atoms) can result in a considerable flow of the plasma particles. In the case of an electron beam-produced plasma the flow velocity of the plasma electrons can be an appreciable fraction of the beam velocity. Some indirect measurements on such a plasma support these high plasma flow velocities, and it is thought that a similar phenomenon could explain some results obtained on an ion beam produced plasma. (France)

21408 COMPUTATION OF AN EXPLOSIVE INSTABILITY IN AN ELECTRON BEAM–PLASMA SYSTEM. Oestberg, K.; Wilhelmsson, H. (Chalmers Univ. of Tech., Goteborg). pp 159 of Fifth European Conference on Controlled fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The coupling coefficients and the evolution in time of the wave amplitudes are computed numerically for three-wave couplings between high-frequency longitudinal plasma waves in an electron beam–plasma system. (France)

21409 DEVELOPMENT AND SATURATION OF THE CROSS-FIELD CURRENT DRIVEN INSTABILITY. Biskamp, D.; Chodura, R. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 177 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The anomalous resistivity observed in collisionless shock waves and theta pinches is generally believed to be caused by an electrostatic instability driven by an electric current perpendicular to the magnetic field. Results concerning numerical simulations of the very nonlinear phase of the instability (in particular the effective collision frequency and the switch-off drift velocity) are presented. (France)

Thermonuclear Engineering and Equipment

Refer also to abstracts 19763, 19767, 19768, 20312, and 20393.

21410 (CONF-721111-21) ANALYSIS OF THE MATERIAL CONSTRAINTS ON SUPERCONDUCTING C.T.R. MAGNETS. DeMichele, D. W.; Darby, J. B. Jr. (Argonne National Lab., Ill.). Nov 1972. 42p. Dep. NTIS.

From the International Meeting on the Technology of Controlled Thermonuclear Fusion Experiments and the Engineering Aspects of Fusion Reactors; Austin, Texas, United States of America (USA) (20 Nov 1972).

The attainment of high magnetic fields with superconducting magnets is crucial to the development of controlled thermonuclear fusion reactors (C.T.R.) as an economic source of power. A detailed model of a tokamak fusion reactor was developed to determine the optimal design to yield maximum power output for several sets of dimensional, operational, and material parameters. The principal objectives of this study were to determine an upper limit on magnet performance and to study the relative importance of various material properties on this performance. Three potential superconducting materials, Nb_3Sn, Nb–22% Ti, and Nb–48% Ti, and two stabilizing metals, copper and aluminum, were investigated using three separate designs. The change in magnet performance was evaluated for variations in the following materials properties: modulus of elasticity of the structural material, maximum stress limit of the stabilizer as well as the electrical and thermal conductivity of the stabilizer, maximum critical field and critical current of the superconducting material, and the heat transfer coefficient to the coolant. (auth)

21411 (CONF-730302-2) NUCLEAR FUSION CHAIN REACTION APPLICATIONS IN PHYSICS AND ASTROPHYSICS. McNally, J. R. Jr. (Oak Ridge National Lab., Tenn.). 1972. 37p. (SM-170/49). Dep. NTIS.

Nuclear fusion chain reactions have been proposed for supernovae and controlled fusion reactors. The concept of fusion chain reactions is traced, with emphasis on possible applications in physics and astrophysics. Reaction kinetics calculations of D · T and D · ^{3}He fusioning plasmas reveal the presence of suprathermal particles as the end products of the reactions. These suprathermal end products can be active chain centers for the propagation of energy-releasing fusion chain reactions with fuels having $Z \geq 3$. A ^{6}LiD fueled fusion reactor has a calculated Lawson number, $n\tau$, lower by a factor of three compared to a pure-deuterium-fueled fusion reactor. The first ^{6}LiD-fueled fusion reactor will be subcritical, with the electrons sustained at MeV temperatures by electron cyclotron heating. If net power producers using ^{6}LiD fuel are eventually feasible they would be large in size, well reflected and have a high beta ($\beta = 8\pi nkt/B^2$) in order to minimize synchrotron radiation losses. Closed magnetic configurations would also be required to ensure the propagation of fusion chain reactions. Higher-powered dc accelerators would be essential to exploit this field of controlled fusion reactors, although a scientific feasibility experiment may be executed with existing accelerators (~ 2 mA, 4 MeV H_2^+). Present-day astrophysical calculations appear to be inadequate to account for rapid nuclear processes in astrophysical explosions, inasmuch as such calculations neglect the presence of suprathermal chain centers and multiplying chain reactions. The 55-day light decay of Type-I supernovae may possibly be explained by the production of ^{7}Be(53.61 d) in chain-reaction burning of neon and oxygen followed by ^{7}Li burning in the residual star. Evaluation of these new prospects will require more accurate data on and broader coverage of the pertinent nuclear reaction cross sections for fuels Li to S and n, p, d, t, ^{3}He, and α particles as suprathermal (E up to 20 MeV) chain centers. (auth)

21412 (IPPJ-127) SYSTEM OF INNER CURRENT ANNULI ARRANGED ALONG THE MINOR AXIS OF A TORUS. Mohri, A.; Uchida, T. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1972. 29p.

A magnetic-field configuration produced by immersing poloidal current rings in a toroidal magnetic field is examined, covering a wide range range of parameters: number of the rings, aspect ratio of the ring and amount of the ring current. Owing to the toroidal effect, null-field lines shift from their original positions in case of the linear configuration. An averaged magnetic well is certainly formed around the separatrix and, also, local magnetic shear appears due to the toroidal effect. Constant $\oint dl/B$ surfaces close themselves, except for those far from the minor axis. Critical lines where $\delta \oint dl/B = 0$ exist in the bad region of the torus. Cases when the current in the ring is induced by the time variation of the toroidal field are considered. Minimum B can be formed when the number of the ring exceeds a value given by the aspect ratio. (auth)

21413 DEVICE FOR COMPRESSION HEATING OF TOKAMAK DISCHARGES. Furth, H. P.; Yoshikawa, S. (to United States Atomic Energy Commission). U. S. Patent 3,702,163. 7 Nov 1972. Filed date 15 Apr 1970. 8p.

An apparatus is disclosed for heating and compressing a toroidal plasma column. The appratus comprises a toroidal evacuated container, having annular toroidal and poloidal coils centered on the major axis. Interacting fields produce an inward compression of the plasma column toward the major axis characterized by a reduction in the major and minor radii of the plasma column. (Official Gazette)

21414 TOKAMAK APPARATUS (JFT-2) IN JAERI. Itoh, S.; Ohta, M.; Fujisawa, N.; (and others) (Japan Atomic Energy Research Inst., Tokai). pp 3 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The JFT-2 Tokamak device constructed in Japan is described and its expected performance is presented. (France)

21415 DOUBLET II EXPERIMENT. Jensen, T. H.; Fisher, R. K.; Hsieh, C. L.; Ohkawa, T. (Gulf General Atomic, Inc., San Diego, CA). pp 4 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Doublet is a magnetic field configuration for heating and confinement of a toroidal plasma. It employes a poloidal as well as toroidal magnetic field. The cross section is noncircular with three magnetic axes. The important feature is that β may be more than ten times larger in doublets than in tokamaks. (France)

21416 MINIMUM SIZE FOR AN IGNITION TOKAMAK. Sweetman, D. R. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). pp 5 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

In order to establish the minimum size for an ignition experiment, a simple two-temperature heating model was used to study the neutral-injection heating of large tokamaks. A simple relation between the plasma current and the minimum temperature for self-sustaining ignition is obtained. This shows that, in laboratory-scale experiments, true ignition occurs at much higher temperatures than is the case with reactor dimensions. Because of the limitations of ohmic heating and synchrotron radiation it is difficult to achieve this condition without additional heating. However a modest amount of, for example, neutral-injection heating (typically a few hundred kilowatts) should be sufficient to reach the self-sustaining condition. (France)

21417 LOCAL DIVERTOR FOR A TOKAMAK. Colven, C.; Gibson, A.; Stott, P. E. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). pp 6 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

A new type of local divertor for a tokamak is described. The divertor causes a field perturbation at the plasma center which is less than 1% of the toroidal field. (France)

21418 ANOMALOUS PINCH EFFECT IN TOKAMAKS. Bussac, M. N.; Laval, G.; Pellat, R. (Ecole Polytechnique, Paris). pp 33 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The existence of an anomalous pinch effect is demonstrated for the case when the turbulent fields are generated by current instabilities. This effect is similar to the Ware–Galeev effect with the stationary electric force replaced by the drag force resulting from the asymmetry of the turbulent fields. The analysis is simplified by considering only the banana regime. The results are easily extended to the plateau regime. (France)

21419 NUMERICAL RESULTS ON THE INFLUENCE OF THE AXIAL ANTIPARALLEL BIAS MAGNETIC FIELD ON THE ENERGY TRANSFER IN A HIGH-BETA DIFFUSE PINCH. Nalesso, G. F.; Ortolani, S. (Univ., Padua). pp 43 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Numerical results obtained using a one-dimensional MHD computer program, including an anomalous description for the plasma resistivity, show that an increase in the axial reversed bias field enhances the energy transfer in a pinched plasma. (France)

21420 CULHAM SUPERCONDUCTING LEVITRON. Riviere, A. C.; Sweetman, D. R. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). pp 95 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

A levitron with superconducting coils which will operate with a levitated ring current of 0.5 MA is now nearing completion at Culham Laboratory. A description of the apparatus, the main physics aims and the present status are presented. (France)

21421 GENERATION OF FIELD-REVERSING RINGS OF RELATIVISTIC ELECTRONS USING INJECTION OF HIGH-CURRENT ELECTRON BEAMS. Bzura, J. J.; Fessenden, T. J.; Fleischmann, H. H.; (and others) (Cornell Univ., Ithaca, NY). pp 96 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Astron-type injection of 500-keV, 10-kA electron beams into a mirror leads to electron rings exhibiting field changes delta B/B_{vacuum} of up to 120% in the trap center and lifetimes of up to 20 μsec. The decay of these layers appears to be dominated by the scattering of the relativistic electrons in the background gas. (France)

21422 INTENSE RELATIVISTIC ELECTRON BEAMS FOR NUCLEAR FUSION. Davitian, H.; Gardner, W. L.; Nation, J. A. (Cornell Univ., Ithaca, NY). pp 164 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

A study of the production and transport of small cross section intense relativistic electron beams, suitable for the study of the interaction processes between the beam and the dense plasma target, is presented. (France)

Wave Phenomena

21423 (IPPJ-124) ION CYCLOTRON WAVE GENERATION IN A TWO-ION PLASMA. Toyama, H.; Matsuura, K. (Nagoya Univ. (Japan). Inst. of Plasma Physics). May 1972. 25p.

Exact calculation of the dispersion relation of cold plasma shows different behaviors from usual approximate theory, neglecting electron inertia in the low-density limit. The limiting value of Ω for optimum coupling is different from unity. This was ascertained experimentally in the QP machine. Experimental observations of optimum coupling of an ion cyclotron wave in the two-ion plasma of the QP machine are presented as functions of plasma density. Plasma was produced by a PIG discharge, and the density was from 10^{10} to $2 \times 10^{12}/cm^3$. The wave was generated by a Stix-type coil (coil wavelength 50 cm) fed by a 4.4-MHz 20-kW oscillator. Experimental data agree qualitatively with the dispersion relation of a homogeneous cold plasma column with sharp boundary. The dependence of optimum loading on the diameter of plasma column disagrees, however, with the theoretical prediction. (auth)

21424 (IPPJ-125) HYBRID RESONANCE DUE TO TWO-ION SPECIES IN A PLASMA. Toyama, H. (Nagoya Univ. (Japan). Inst. of Plasma Physics). May 1972. 12p.

Hybrid resonance due to two-ion species (H^+ and H_2^+) was observed in a fully ionized plasma for the density range (2×10^{11} to 1.6×10^{12} cm^{-3}) using a Stix-type induction coil. The resonance condition, found experimentally, was in good agreement with theoretical predictions. (auth)

21425 DISPERSION DIAGRAM OF THE PLASMA WAVES ON THE PLASMA BRANCH IN A BEAM-CREATED PLASMA. Gueltekin, E.; Hopman, H. J. (Fom-Institut voor Atoom-en Molecuulfysica, Amsterdam). Istanbul Univ. Fen Fak. Mecm., Seri C; 35: No. 1-4, 105-114(1970).

In an electron beam–plasma system the dispersion diagram of the plasma wave was determined by means of an interferometer method. The relation between the phase velocity of the plasma instability and the beam velocity was measured. The plasma density is measured with a Langmuir probe and obtained from dispersion characteristics of the plasma. (auth)

21426 DAMPING OF A SOLITON IN A PLASMA. Shapiro, V. D.; Shevchenko, V. I. (Physical-Technical Inst., Kharkov). JETP Lett. (USSR) (Engl. Transl.); 16: No. 8, 347-350(20 Oct 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 8, 487-491(20 Oct 1972).

The adiabatic damping of a soliton as a result of absorption of its energy by resonance plasma particles is studied. A theoretical analysis is presented for damping of a hf Langmuir soliton. (MOW)

21427 NONLINEAR PLASMA OSCILLATIONS NEAR THE BOUNDARY LIMITS. Berman, G. P.; Zaslavskii, G. M. (Inst.

of Physics, Erevan). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 15: No. 10, 1456-1463(1972). (In Russian).

The spectrum of these oscillations was found. The interaction of two nonlinear plasma waves with strongly different periods was considered. The conditions have been obtained under which the energy exchange between waves does not take place. The corrections on each wave velocity are found. The agreement of the results obtained with numerical experiments is discussed. (auth)

21428 INFLUENCE OF COLLISIONS ON ELECTROMAGNETIC WAVE PROPAGATION IN A PLASMA FORMED BY A MOVING IONIZATION SOURCE. Semenova, V. I. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 15: No. 12, 1793-1800(1972). (In Russian).

The influence of collisions on electromagnetic wave propagation in plasma formed by a moving ionization source is considered. Formulas are obtained that characterize the wave attenuation in plasma behind the front in different limited cases, depending on the relations between the Langmuir frequency of plasma electrons and the effective collision frequency. The fields behind the ionization front in the limiting case of the higher front velocities close to the velocity of light ($v_0 \to c$) are found. (auth)

21429 PROPAGATION OF ION ACOUSTIC WAVES IN A WEAKLY IONIZED PLASMA. Behnke, J.; Kagel, H.; Leven, R. (Ernst-Moritz-Arndt-Univ., Greifswald, Ger.). Beitr. Plasmaphys.; 12: No. 4, 263-275(1972). (In German).

The existence range of ion acoustic waves in a dc-helium discharge is determined experimentally. In addition, some theoretical estimations about the properties of propagation of this type of wave are given, including ion–neutral and electron–neutral elastic collisions. For the purpose of comparison of theoretical and experimental results, extensive and systematic measurements of the plasma parameters were made. In agreement with the theoretical predictions, damped ion acoustic waves were observed in the whole existence range. Some differences between the quantitative results of linear theory and experiment were found. It is supposed that these discrepancies result from nonlinear effects. (auth)

21430 ELECTROMAGNETIC WAVE PROPAGATION AND RADIATION IN A SUDDENLY CREATED PLASMA. Jiang, C. L. Pasadena, CA; California Inst. of Tech. (1973). 80p. University Microfilms Order No. 73-1530.

Thesis (Ph.D).

Propagation and radiation of electromagnetic waves from oscillating sources in a suddenly created plasma are studied. Field expressions are derived through the use of Laplace transformations. The spatial distribution of sources is taken to be arbitrary but confined. Two cases are considered in detail: (1) plane wave propagation in a source-free region, and (2) electric point dipole radiation. In the case of plane wave propagation, various aspects as wave split, frequency shift, phase and group velocities, amplitude changes, power flows and energy relations are discussed. In the case of electric dipole radiation, the electromagnetic fields and instantaneous radiated power are calculated and expressed in terms of Lommel functions of two variables. Asymptotic expressions and graphical results of numerical calculations of these quantities are presented. Many interesting properties of the spherical waves and power radiation are discussed. (Diss. Abstr. Int., B)

21431 DISPERSION OF ELECTROSTATIC ION PLASMA WAVES NEAR HARMONICS OF THE ION CYCLOTRON FREQUENCY. Melton, J. G. Austin, TX; Univ. of Texas (1972). 124p. University Microfilms Order No. 73-485.

Thesis (Ph.D).

Plasma waves that can propagate in a hot magnetized plasma near harmonics of the ion cyclotron frequency (Ω_{ci}) were studied numerically in the electrostatic approximation. The effects of collisionless damping processes and of finite ion Larmor radius were included. The results obtained were compared first to those obtained from common approximate equations, to determine when the approximate results are adequate to describe the waves, and then to the experimental results which have been obtained at several laboratories. The numerical results show that the ion Bernstein (IB) mode, which has a resonance at each harmonic of Ω_{ci}, is tightly constrained to perpendicular propagation. If the IB wave deviates by as much as 1° from the perpendicular in hydrogen plasma, it is heavily Landau damped by electrons. In gases with heavier ions, the angle must be even closer to perpendicular for propagation to occur. The acoustic mode, including the ion acoustic (IA) mode and the electrostatic ion cyclotron (EIC) mode, can propagate along and at an angle to the magnetic field and may show resonant dispersion at harmonics of Ω_{ci} depending on the angle of propagation. At smaller angles of propagation, typically less than 20°, the wave is only lightly affected by the cyclotron resonance at Ω_{ci} and at each harmonic. At larger angles of propagation, typically between 20° and 80°, the IA–EIC mode shows resonant dispersion at Ω_{ci}, and also at harmonics of Ω_{ci} if the angle is large enough. At successively higher harmonic numbers, the angle must be progressively larger for resonant dispersion to occur. At even larger angles, typically greater than 80°, propagation of the IA–EIC mode is limited by electron Landau damping. In general, it was found that, while the approximate dispersion equation can give a fairly accurate description of the waves, it is usually better to use the complete electrostatic dispersion equation. A comparison of the numerical results with the experimental measurements which have been made at several laboratories has confirmed some of the theoretical features of the waves, though more thorough experimental investigations are needed to verify the details. (Diss. Abstr. Int., B)

21432 INTERACTIONS BETWEEN TRAVELING WAVES AND PLASMA IN A MAGNETIC FIELD. Osovets, S. M.; Popov, I. A. (Inst. of Atomic Energy, Moscow). pp 8 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Excitations of a toroidal current and volume hf field in plasmas were studied in traveling-wave confinement experiments in the presence of a longitudinal magnetic field. (France)

21433 RESONANT SCATTERING OF TRAPPED PARTICLES BY TOROIDAL PLASMA MODES. Coppi, B. (Massachusetts Inst. of Tech., Cambridge); Minardi, E.; Schram, D. C. pp 34 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

In two-dimensional configurations electrostatic modes are shown to be excited with frequency and parity characteristics such as to affect significantly the orbits (quasi bananas) of trapped ions by proper mode–particle resonances. Processes of this kind may in fact provide an effective scattering mechanism in regimes where the single-particle collision mean free paths are considerably longer than the periodic particle excursions. (France)

21434 EFFECTS OF AN ELECTROSTATIC TURBULENCE ON TRAPPED PARTICLES IN TOROIDAL PLASMAS. Dobrowolny, M. (European Space Research Inst., Frascati, Italy); Orefice, A.; Pozzoli, R. pp 35 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The possible effects of weakly turbulent electrostatic waves on the motion of trapped particles in toroidal plasmas are considered. The possibility of the stochastic scattering of trapped particles into the untrapped region of velocity space is discussed, the different types of wave which can exist in plasma experiments being considered. (France)

21435 INTERACTION OF ELECTROMAGNETIC WAVES WITH PLASMA OF A TOROIDAL DISCHARGE. Gladkovskii, I. P.; Golant, V. E.; Dyatchenko, V. V.; Larionov, M. M.; Lewin, L. S.; Rozhdestvenskii, V. V.; Sadovnikov, V. A.; Shcherbinin, O. N. (Ioffe Inst. Of Physics and Tech., Leningrad). pp 109 of Fifth European conference on controlled fusion and plasma physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The tokamak device of A. P. Ioffe Physico-Technical Institute is described. Ohmic heating and electromagnetic wave interaction with the plasma in the lower-hybrid-frequency range were studied. It was found that energetic ions are generated by high-frequency power in a plasma. (France)

21436 LOADING OF A RF HELIX BY A HOT MAGNETIZED PLASMA COLUMN. Messiaen, A. M.; Dubois, D. M.; Vandenplas, P. E. (Ecole Royale Militaire, Brussels). pp 115 of Fifth European conference on controlled fusion and plasma physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The principal results concerning the loading of a slow wave (double helix) structure by a magnetized plasma column are presented. A broad frequency range (from $\omega \ll \omega_{ci}$ up to $\omega > \omega_{LH}$) is considered. Loading resonances occur in different frequency domains and depend upon the characteristics of the helix, the way in which it is fed, and the plasma parameters. (France)

21437 NONLINEAR LIMITS TO THE THEORY OF RESONANT ABSORPTION IN COLD PLASMAS. Anicin, B. A.; Babovic, V. M. (Boris Kidric Inst. of Nuclear Science, Belgrade). pp 119 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

It is shown that resonant absorption in the vicinity of a singular layer of a cold nonuniform plasma capacitor cannot be regarded as a purely collisionless effect. A limited number of collisions are essential in the process. A nonequality is derived, which sets an upper limit to the applied electric field. If this limit is exceeded, the problem becomes essentially nonlinear. (France)

21438 ANOMALOUS MICROWAVE ABSORPTION NEAR THE PLASMA FREQUENCY. Dreicer, H.; Ellis, R. F.; Ingraham, J. C. (Los Alamos Scientific Lab., NM). pp 120 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

A microwave resonator is used to excite and measure anomalous absorption in a plasma column. A parametric-instability-like threshold is observed in both plasma density and microwave electric field for the anomalous absorption onset as well as for the appearance of hot electrons. (France)

21439 ABSORPTION OF THE MICROWAVE ENERGY IN A MAGNETOACTIVE PLASMA. Musil, J.; Zacek, F. (Inst. of Plasma Physics, Prague). pp 126 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The possibility of microwave absorption in a magnetoactive plasma was studied experimentally for an arbitrary value of the magnetic field B ($B < B_{ce}$, B approximately equal to B_{ce} and $B > B_{ce}$, where B_{ce} is the magnetic field corresponding to the electron cyclotron resonance). (France)

21440 DYNAMICS OF WEAK NONLINEAR INTERACTIONS BASED ON ENERGY AND MOMENTUM CONSERVATION. Jungwirth, K. (Inst. of Plasma Physics, Prague). pp 131 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Two examples are presented which demonstrate that the concepts of energy and momentum are very effective tools for studying various weak nonlinear interactions: average hydrodynamic force exerted by a given wave on plasma particles; and the temporal evolution of the weak three-wave nonlinear interaction. (France)

21441 EXPERIMENTAL RESULTS ON THE DAMPING OF A FINITE-AMPLITUDE ELECTRON WAVE. Franklin, R. N.; Hamberger, S. M.; Smith, G. J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). pp 132 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Experimental measurements of the collisionless damping of a finite amplitude electron wave show that recent self-consistent numerical solutions of the nonlinear Vlasov equation are adequate. (France)

21442 RESONANT INTERACTION OF TWO ELECTRON WAVES WITH AN ION WAVE. Franklin, R. N.; Hamberg, S. M.; Smith, G. J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). pp 133 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Observation of the resonant interaction between two coherent electron waves and ion wave is reported. Measurements of the complex ion wave dispersion, necessary to calculate the interaction strength, are also presented. (France)

21443 PARAMETRIC EXCITATION OF LONGITUDINAL WAVES IN MAGNETOACTIVE ELECTRON PLASMA. Tskhakaya, D. D.; El Ashri, M. Y. (Inst. of Physics, Tbilisi, USSR). pp 135 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The stability (with respect to hf potential oscillations) of a purely electron plasma placed in a strong hf electric field and a constant magnetic field was studied. Cold plasmas are considered. It is assumed that the ions are at rest. The relativistic nature of the motion in external fields causes oscillations of the electron mass, which lead to parametric amplification of the electron oscillation in the plasma. (France)

21444 NONLINEAR GENERATION OF HARMONIC OF THE CYCLOTRON FREQUENCY. Cano, R.; Fidone, I.; Granata, G. (CEN, Fontenay-aux-Roses, France). pp 136 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Experimental results concerning the nonlinear generation of harmonics of an electromagnetic wave are presented. A possible explanation of emission at the cyclotron resonance frequency is given. (France)

21445 NONLINEAR PLASMA OSCILLATIONS IN TERMS OF VAN KAMPEN MODES. Best, R. W. B. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas, Netherlands). pp 137 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The equations of Vlasov and Poisson are expanded in the field amplitude. The expansion is free from singularities and squares of delta functions. The Van Kampen modes are re-established in the first order. The second order distribution function is also dominated by Van Kampen modes. (France)

21446 ADIABATICITY RELATIONS FOR SLIGHTLY NONLINEAR ELECTRON PLASMA OSCILLATIONS. Bertrand, P. (Univ., Nancy); Felix, M. R. pp 139 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The connection between hydrodynamic, single water-bag and Vlasov models was studied. At long wavelengths, slightly nonlinear excitation and systems in which the usual adiabatic invariant Pn^{-3} is space independent occur, this latter quantity remains space and time independent. With other initial conditions a nonadiabatic jump takes place. (France)

21447 TRAPS FOR WAVES IN TRAPS FOR PLASMA. Deutsch, R. V.; Goldenberg, D.; Grosu, I.; (and others). pp 143 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

It is shown that in the vicinity of the resonant frequency, wave trapping can occur in plasma traps. A local periodic increase in the plasma density can thus take place in experimental plasma traps. (France)

21448 EFFECTS OF ANISOTROPIC PLASMA TEMPERATURE ON THE FREQUENCY SHIFT IN RESONANT CAVITIES. Saison, R. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). pp 144 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Anisotropic temperature effects in inhomogeneous plasmas in resonant cavities are studied. For the TM_{OMO} mode (transverse magnetic mode), the wave equation can be treated exactly in both the limiting cases $T_{||} \ll T_{\perp}$ and $T_{||} \gg T_{\perp}$. It is shown that the parallel temperature may be responsible for the absence of frequency shift. (France)

21449 EIGENVALUES OF A MICROWAVE CAVITY PARTIALLY FILLED WITH A WARM PLASMA. Shohet, J. L.; Rissman, P. (Univ. of Wisconsin, Madison). pp 145 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The eigenvalues of a microwave cavity containing a warm plasma are computed. For various values of mode indices, the acoustic and electromagnetic modes can be coupled. The behavior of the eigenvalues as a function of plasma density and thermal speed is shown. (France)

21450 ELECTROMAGNETIC FLUCTUATIONS IN A SEMI-BOUNDED NONEQUILIBRIUM PLASMA. Sitenko, A. G.; Yakimenko, I. P. (Inst. of Theoretical Physics, Kiev). pp 162 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The theory of electromagnetic fluctuations in the half-space of a two-component plasma was studied for the case of electrons moving with a constant drift velocity with respect to the ions. The special properties of the fluctuation spectrum resulting from the presence of the boundary are discussed. (France)

21451 SHOCK WAVE IN A LONGITUDINAL MAGNETIC FIELD. El-Khalafavy, T. A.; Masoud, M. M.; Beshara, A. B.; Zemskov, A. I. (Atomic Energy Commission, Cairo). pp 165 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Shock-wave propagation in hydrogen was investigated. Oscillations of the wave front were revealed in the transient regime. Free propagation and propagation under a bias field were compared. Changes in the initial state of the test gas due to the operation of the source were studied. (France)

21452 ELECTRONIC THERMAL SHOCK WAVE IN COLLISIONLESS PLASMA. Ivanov, A. A.; Kozorovitskii, I. I.; Rusanov, V. D.; Sagdeev, R. Z. pp 167 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The propagation of a hot electron cloud in a collisionless plasma was studied. The instantaneous profiles of the pressure inside the plasma and the plasma potential are presented. (France)

21453 THICKNESS OF PERPENDICULAR COLLISIONLESS SHOCKS. Cairns, R. A. pp 168 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The variation with β of the thickness of a laminar wave, propagating perpendicular to a magnetic field, is calculated. This variation is found to be similar to that of experimentally observed shocks. (France)

21454 EXPERIMENTAL STUDY OF OBLIQUE SHOCK WAVES. Nakai, S.; Mizui, J. I.; Yamanaka, C. (Osaka City Univ.). pp 169 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Oblique shock waves in high-β plasmas have a monotonic structure and are preceded or proceeded by magnetoacoustic fluctuations. Spectroscopic observations of the H_β line revealed that the dip at the center had disappeared. Satellites that may be related to turbulent processes in the shock region also occurred. Ion heating resulted in a double temperature component. (France)

21455 NUMERICAL EVALUATIONS OF WAVE-WAVE CONTRIBUTIONS TO THE HIGH-FREQUENCY RESISTIVITY OF NONEQUILIBRIUM PLASMA. Hirshfield, J. L.; Ratner, A. S.; DeAngelis, D. L. (Yale Univ., New Haven). pp 172 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Numerical evaluations are presented for the wave-wave part of the high-frequency plasma resistivity, for nonequilibrium unmagnetized plasma. Variation in electron-to-ion temperature ratio and electron drift speed is taken into account. No dramatic anomalous resistivity values are predicted by linear theory. (France)

21456 ION MASS EFFECT ON THE SPECTRUM OF NONLINEAR ION ACOUSTIC TURBULENT FLUCTUATIONS IN A CURRENT-CARRYING PLASMA. Perepelkin, N. F.; Suprunenko, V. A.; Vasil'ev, M. P.; Diki, A. G. (Physical-Technical Inst., Kharkov). pp 173 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European conference on controlled fusion and plasma physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The results presented confirm a hypothesis about the excitation of short wave ion-acoustic oscillations of a quasi-stationary current in the Uragan stellarator. The wave processes taking place in the plasma exhibit a very nonlinear dynamic character. The width of the instantaneously observed fluctuation spectrum is extremely narrow. (France)

21457 SPONTANEOUS EXCITATION OF ION-ACOUSTIC WAVES IN A DC DISCHARGE IN HELIUM. Fenneman, D. B.; Raether, M.; Yamada, M. (Univ. of Illinois, Urbana). pp 174 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The excitation of ion-acoustic waves in a dc discharge was investigated under conditions where ion-neutral collisions are the dominant damping mechanism. Measurements of the onset parameters, frequency spectrum, and spatial distribution of unstable waves are presented and compared with theoretical predictions. (France)

21458 COLLECTIVE INTERACTION IN ION WAVES IN Q MACHINES. Christoffersen, G. B.; Jensen, V. O.; Prahm, L. P. (Danish Atomic Energy Commission, Risoe). pp 175 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

Solutions of the Vlasov equations for ion-acoustic waves with $T_e \sim T_i$ demonstrate that the effect of collective interactions is negligible. This fact is confirmed by experiments. When $T_e \gtrsim 3T_i$, collective interactions produce oscillations in the (x,v) space velocity distribution function. (France)

21459 NONLINEAR EFFECTS OBSERVED AT PARAMETRIC INTERACTION OF THE EXTERNAL ELECTRIC FIELD WITH ION ACOUSTIC OSCILLATIONS IN PLASMA. Barkhudarov, E. M.; Kervalishvili, K. A.; Kortkhondzhiya, V. P.; Tsintsadze, N. L.; Tskhakaya, D. D. (Inst. of Physics, Tbilisi, USSR). pp 176 of Fifth European Conference on Controlled Fusion and Plasma Physics. Vol. 1. Grenoble, France; Centre d'Etudes Nucleaires (1972).

From 5th European Conference on Controlled Fusion and Plasma Physics; Grenoble, France (21 Aug 1972). See CONF-720804-.

The interaction of low-frequency electric fields with ion-acoustic oscillations in confined plasmas was studied. An attempt is made to explain the observed suppression of ion-acoustic oscillations on the basis of nonlinear interactions between natural modes. (France)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 20719, 20720, 20899, 21011, 21014, and 21525.

21460 (AD-743180) MODELS OF RADIATION TRANSPORT IN AIR: THE ATR CODE. Final Report, April 1, 1970-November 15, 1971. Harris, R. J.; Lonergan, J. A.; Huszar, L. Jr. (Science Applications, Inc., La Jolla, Calif. (USA)). Nov 1971. Contract DASA01-70 C-0090. 119p. (SAI-71-557-LJ; DNA-28031).

The work to date is described on development of the ATR computer code-a user-oriented code for calculating quickly and simply radiation environment problems at all altitudes in the atmosphere. The ATR code is based on parametric models of a comprehensive data base of air base transport results which was generated using rigorous transport techniques for infinite homogeneous air. The effects of an air-ground interface and nonuniform air density are treated as perturbation corrections on homogeneous-air results. The data base has been generated for neutrons, secondary gamma-rays, high-energy photons and low energy photons as a function of space, energy and angle out to range of 550 gm/cm squared of air. Parametric models were developed for all of this data base except photon angular distribution and a version of ATR was completed for neutron and secondary gamma-ray transport. (auth) (GRA)

21461 (LA-5159) PROJECTED MULTIPLE SCATTERING DISTRIBUTIONS. Hutson, R. L. (Los Alamos Scientific Lab., N. Mex.). Jan 1973. Contract W-7405-eng-36. 4p. Dep. NTIS.

Results are presented from calculations of the distribution of scattering angles arising as a result of gaussian multiple scattering. (auth)

21462 (ORNL-4811) HEALTH PHYSICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JULY 31, 1972. (Oak Ridge National Lab., Tenn.). Sep 1972. Contract W-7405-eng-26. 133p. Dep. NTIS.

Separate abstracts were prepared for the 16 included sections. (MOW)

For abstracts of individual sections see: 19892, 19903, 20069, 20070, 20153-20156, 20719, 21463-21467, 21525, and 21871.

21463 (ORNL-4811, pp 1-12) THEORETICAL RADIATION PHYSICS. Ritchie, R. H.; Alton, G. D.; Anderson, V. E; (and others). Sep 1972.

In Health Physics Division annual progress report for period ending July 31, 1972.

The mean energy deposited in water spheres by high-LET (>170 MeV/cm in water) particles produced directly as a result of π^- capture by oxygen and carbon is shown as a function of the distance from the capture site. In the case of pion capture by oxygen the added dose due to neutrons resulting from the capture is also shown. A Monte Carlo code was used to compute electron-slowing-down spectra in neutron-activated silicon. The resulting fluxes are presented in histogram form in the energy range from 10 to 10^4 eV. The J = 0 angular momentum component of the elastic cross sections is shown as a function of dipole moment for 0.03 electrons on a linear polar molecule. Data are given for five different choices of effective charge. Total momentum transfer cross sections are shown as a function of dipole moment for 0.03 eV electrons on a model polar molecular system. The cross section for a pure dipole target and the Born cross section for a pure dipole are also shown for reference. Thermal energy (300°K) momentum transfer cross sections as derived from electron swarm experiments are compiled. The thermally averaged momentum transfer cross section obtained from the Born approximation for a point dipole is plotted. Results for elastic and total scattering cross sections obtained for electrons on hydrogen are shown. The inverse mean free path measured in $Å^{-1}$ was evaluated as a function of incident electron energy (in multiples of the Fermi energy) for an electron gas density equal to the conduction band electron density in aluminum. (MHR)

21464 (ORNL-4811, pp 19-24) PHYSICS OF TISSUE DAMAGE. Arakawa, E. T.; Birkhoff, R. D.; Cochran, W. T.; (and others). Sep 1972.

In Health Physics Division annual progress report for period ending July 31, 1972.

A careful exploration was made of the slowing-down spectrum in silicon using a finer energy mesh and a stronger electron source than in previous work. The slowing-down spectrum of ^{163}Dy beta particles in aluminum oxide is shown. The variation of electron flux with source thickness was plotted for gold from 780 Å to 5 mils. In a continuing study of the optical properties of organic liquids in the vacuum ultraviolet, the absorption cross section per molecule is shown for three frequently used solvents: carbon tetrachloride (CCl_4), liquid n-hexane (C_6H_{14}), and cyclohexane (C_6H_{12}), together with the vapor data where available. The dielectric constants and energy-loss function for granine at photon energies from 14 to 82 eV are shown. (MHR)

21465 (ORNL-4811, pp 35-46) ATOMIC AND MOLECULAR RADIATION PHYSICS. Christophorou, L. G.; Anderson, V. E.; Birks, J. B.; (and others). Sep 1972.

In Health Physics Division annual progress report for period ending July 31, 1972.

The topics in atomic and molecular radiation physics cover the electron attachment process, structure in the cross sections for capture of slow electrons by O_2 to form O_2^-, lifetimes of long-lived polyatomic negative ions, unimolecular decompositions, mobilities of thermal electrons in gases and liquids, the scattering of slow electrons by π-electron-containing organic molecules, and compound negative-ion resonances and threshold-electron excitation spectra of quinoline and isoquinoline. Also covered are energy-loss spectra of N-heterocyclic benzene derivatives, threshold-electron excitation and compound negative-ion formation in methane, ethane and propane, emission spectra from higher excited π-singlet states of aromatic hydrocarbons in solution, and low-energy electron interactions with liquids. (JFP)

21466 (ORNL-4811, pp 49-61) DOSIMETRY FOR HUMAN EXPOSURES AND RADIOBIOLOGY. Poston, J. W.; Auxier, J. A.; Cheka, J. S.; (and others). Sep 1972.

In Health Physics Division annual progress report for period ending July 31, 1972.

A large collimator was mounted on top of the Health Physics Research Reactor (HPRR) Control Building and used to measure the angular distribution of scattered neutron and gamma doses received at that point from the HPRR on the other side of a hill. The results are plotted. The absolute doses per neutron per square centimeter incident on a 30-cm-diam by 60-cm cylindrical tissue-equivalent phantom for neutrons from the HPRR and from 14-MeV (d,t) neutrons were calculated. The results are shown and compared with Monte Carlo calculations. The dose from recoil ions produced by neutrons from a 20-mm ^{252}Cf needle source for three compositions of tissue media is tabulated. The dose and dose equivalent are shown for neutron energies of 0.025 eV (thermal), 10 keV, 1 MeV, and 7 MeV, where the beam makes an angle of 45° with the axis of a tissue cylinder. Attenuation coefficients for skeletal, lung, and soft tissue are presented. The results of calculations of dose to the skin from a broad parallel beam of photons for unilateral anterior exposure are tabulated. Ratios of entrance to exit dose for monoenergetic photons and the ratio of dose at a depth of 5 cm to average red marrow dose are shown. The results of measurements at the Biology Division ^{252}Cf irradiation facility of neutron and gamma dose as a function of distance from the source and of the symmetry of the neutron and gamma dose on an arc around the sources are presented. The ratio of scattered to total neutron dose measured using the shadow-cone techniques is shown. (MHR)

21467 (ORNL-4811, pp 74-7) INTERACTION OF CHARGED PARTICLES WITH MATTER. Hurst, G. S.; Bartell, D. M.; Bortner, T. E.; Garrett, W. R.; Talmage, J. E.; Wagner, E. B. Sep 1972.

In Health Physics Division annual progress report for period ending July 31, 1972.

An energy degradation scheme for the primary particle and secondary electrons is shown for 1- and 4-MeV protons in helium. The pressure dependence of the 584-Å decay rate for helium is shown. An energy pathways model suggested to explain continuum formation and Jesse effects in helium is diagrammed. The transport of resonance radiation and an operational rationale for radiation protection are discussed. (MHR)

21468 RELATIONSHIP BETWEEN THE X-RAY PATTERN, PHOTON ENERGY AND DOSE FOR A SIMPLE PHANTOM. Lerch, I. A. (Univ. of Chicago). Phys. Med. Biol.; 17: No. 6, 803-13(Nov 1972).

The interrelationship of object contrast, diagnostic beam photon energy and structure size was examined for a simple phantom system consisting of a 20 cm thick Lucite slab with aluminum cylinders of different diameters placed at the midline. The dependence

of object contrast on the fraction of the incident primary beam transmitted to the image plane, expressed as a function of photon energy and cylinder diameter, was determined in order to show the cost of object contrast in terms of exposure. The object contrast dependence on photon energy for the various relative energy flux density profiles for cylinders of different diameters was calculated as functions of the spatial frequency spectra amplitudes. An analysis is given which demonstrates the reduction in exposure to be obtained, for equal values of object contrast, using monoenergetic beams as opposed to 85 kV_p x-rays. Reductions in exposure of about 19 to 22% were found for aluminum cylinders of 4 mm and 8 mm diameter respectively. (auth)

21469 ENERGY DEPOSITION PRODUCED BY FAST-NEUTRON IRRADIATION IN SMALL TISSUE-EQUIVALENT VOLUMES. Heintz, Philip Howard. Seattle, Wash.; Univ. of Washington (1972). 198p. University Microfilms Order No. 72-15,101.

Thesis.

The distribution of ionizing events produced by fast-neutron irradiation of volumes of cellular size was investigated. Both experimental and theoretical techniques were used. The distribution of ionizing events was measured for monoenergetic neutron energies of 327 and 733 keV and 1.48, 2.95, and 14.6 MeV. Also measured was the distribution of events inside a tissue-equivalent medium bombarded by an external source of 14.6 MeV neutrons. The measurements were made with a commercial ½-inch spherical proportional counter constructed with walls of tissue-equivalent plastic and filled with tissue-equivalent gas at low pressures. By maintaining the gas pressure at 28, 56, 113, and 282 torr the sensitive volume of the counter was made equivalent to spheres of unit-density tissue with diameter 0.5, 1.0, 2.0, and 5.0 microns. The theoretical model developed to calculate the distribution of ionizing events from neutron irradiation divided the mechanism of energy transfer into three steps: First, the birth of charged particles was calculated from the interaction of neutrons with a biological medium. Thirteen nuclear reactions were considered. Second, the birth spectrum was used to calculate the equilibrium fluence or spectrum of charge particles. Third, the two spectra were combined to calculate the energy transfer to a slab or a spherical cavity. Four geometric distributions were derived to calculate the event distribution inside the spherical cavity. (Diss. Abstr. Int., B)

21470 INVESTIGATION OF ELECTRON PENETRATION AND X-RAY PRODUCTION IN SOLID TARGETS. Matsukawa, T.; Murata, K.; Shimizu, R. (Osaka Univ.). Phys. Status Solidi (b); 55: No. 1, 371-383(1 Jan 1973).

The Monte Carlo method based on a single scattering model is applied to investigate the behavior of electrons in pure and mixed specimens using the electron probe microanalyzer and the scanning electron microscope. Fairly good agreement is obtained with experiments on electron backscattering, penetration, and x-ray production. The effect of the mean ionization potential on the final results is also discussed. (auth)

21471 QUASI-ELASTIC NUCLEAR INTERACTIONS IN TISSUE-LIKE MEDIA. Watt, D. E. (Univ. of Dundee, Eng.). Phys. Med. Biol.; 17: No. 3, 409-15(May 1972).

Quasi-elastic scattering cross sections for H, D, He, Li, C, N and O particles in tissue-like media were calculated for energies between 10 and 10^7 eV using an empirical form for the interaction potential based on the Lindhard theory. Molecular binding was included. The specific number and type of primary recoil particles produced along the incident particle track and the average energy of the primary recoils were also calculated. The production cross-sections for secondary particles in the restricted cascade are derived for incident particle energies less than 10^5 eV. (auth)

21472 THREE DIMENSIONAL CALCULATION OF NEUTRON DOSE RATES ABOUT IMPLANTABLE ^{252}Cf SOURCES. Windham, J. P. Cincinnati; Univ. of Cincinnati (1972). 206p. University Microfilms Order No. 72-23,594.

Thesis.

The neutron dose rates from implantable ^{252}Cf sources in an infinite system and placed at the center and near the surfaces of cylindrical and parallelepiped tissue equivalent phantoms were calculated. The infinite system point source calculations were performed using the discrete ordinate code DTF-IV. To obtain the dose rates from line sources in an infinite system, the point source solutions were used as a kernel and integrated over the length of the line source. A three dimensional transport code based on the integral form of the neutron transport equation was developed to make the calculations in the finite phantoms. The phantoms were divided into small volume elements and the flux in any one element was determined by adding the uncollided contribution from the source to the scattered-in contribution from all surrounding elements. The calculations used six energy groups, and anisotropic scattering was accounted for by using the multigroup transport approximation. A four element standard man composition was used for the tissue equivalent medium. The six group cross sections were reduced from available 99 group P0 and P1 cross sections. The group cross sections were weighted with the flux and current obtained from a 21 group, P3 discrete ordinate calculation in an essentially infinite system. Charged particle equilibrium was assumed so that absorbed dose could be equated to the kerma. Kerma factors for converting flux to dose were calculated from reported fluence-to-kerma factors. The 21 group infinite system flux was used as a weighting function to calculate the 6 group kerma factors. The absorbed dose rate distributions were obtained by multiplying the neutron group flux by the group kerma factor and summing over the groups. The effects of neutron leakage from the surface of small finite systems were observed. Sources placed parallel and within one centimeter of a surface had reductions in dose rates which were as high as 38 percent of the dose rates for sources placed at the center of the finite systems. Curved surfaces had a larger effect on the reduction of the dose rate than plane surfaces. The reduction in dose rates due to surface leakage appears to be significant, and indicates that results obtained from infinite system calculations and measurements will substantially overestimate the dose rate for sources placed near the surfaces of small finite systems. (Diss. Abstr. Int., B)

21473 DETERMINATION OF THE AVERAGE ENERGY W_L EXPENDED IN AIR PER ION PAIR FORMED FOR 60 MeV TO 120 MeV BREMSSTRAHLUNG. Hohlfeld, K.; Engelke, B. A. (Physikalisch-Technische Bundesanstalt, Brunswick). Biophysik; 9: No. 1, 85-92(1972). (In German).

By calorimetric measurement of the absorbed dose in graphite and the measurement of ionization per unit mass of air under the same conditions the average energy W_L required to produce an ion pair in air was determined for x-rays with maximum energies of 60, 90 and 120 MeV. The value of W_L = 34.0 eV for 60 and 90 MeV x-rays as well as 33.9 eV for 120 MeV x-rays agrees with the well known value of W_L = 33.73 eV as given by the ICRU for energies below 2 MeV. (auth)

21474 CORRECTIONS TO THE BETHE–BLOCH FORMULA FOR AVERAGE IONIZATION ENERGY LOSS OF RELATIVISTIC HEAVY NUCLEI. Close collisions. Morgan, S. H. Jr.; Eby, P. B. (National Aeronautics and Space Administration, Huntsville, AL). Nucl. Instrum. Methods; 106: No. 3, 429-435(1973).

Corrections to the Bethe–Bloch formula for average ionization energy loss of relativistic nuclei are calculated by numerically integrating the exact Mott cross section. Results are tabulated in the form of a correction term $\phi(\beta,Z)$ for nuclei with Z = 6, 12, 26, 36, 52, 60, 75, 80, 92, 104, and 114 and velocities corresponding to β = 0.85, 0.90, 0.95, 0.97, 0.99, and 0.999. These results are compared with closed-form corrections obtained from the second- and third-order Born approximations. Close agreement is found between the corrections from the Mott and third-order Born approximation for $Z \leq 60$ and $\beta \geq 0.85$. (6 figures, 3 tables) (auth)

21475 STOPPING POWER OF Ti, Mo, Ta, AND W FOR 0.50 TO 1.75 MeV PROTONS. Leminen, E. (Univ. of Helsinki). Ann. Acad. Sci. Fenn., Ser. A VI; No. 386, 1-14(1972).

The stopping power for protons in Ti, Mo, Ta, and W has been measured with the backscattering method. The known stopping powers of Cu, Ag, and Au from earlier measurements have been used as references. Possible sources of error are considered and the standard deviation of the stopping powers determined is estimated to be about ±3%. The results agree with other published experimental values and with those tabulated by Northcliffe and Schilling to within the reported errors. (auth)

21476 BIO-MOLECULAR DAMAGE BY LOW ENERGY HEAVY PARTICLES. Watt, D. E.; Hughes, S. (Univ. of Dundee, Eng.). Phys. Med. Biol.; 17: No. 2, 306-9(Mar 1972).

Expectancy values were calculated for the specific number of molecular fragments produced along particle tracks in tissue-like media due to ionization, charge transfer, and quasi-elastic nuclear scattering. The results for protons in ribonuclease are tabulated. Ionization events were due to primary ionization and obtained from published data on cross-sections measured in gases, assuming each ionization produced a molecular fragment. Quasi-elastic nuclear scattering events were calculated from the Lindhard theory modified to include only those hard collisions which can eject whole target atoms from molecules, and in the process lose a small amount of energy inelastically to break the molecular bond. Charge transfer contributions were derived from published work on gases and vapours. (UK)

21477 PROBABILITY DENSITY FUNCTIONS OF IONIZING EVENTS IN THE NEIGHBORHOOD OF A PRIMARY ION OF A CHARGED PARTICLE. Isaev, A. V.; Keirim-Markus, I. B.;

Popov, V. I.; Savinskii, A. K.; Chernova, O. N. Meas. Tech. (USSR) (Engl. Transl.); 15: No. 6, 919-22(Jun 1972).
Translated from Izmer. Tekh.; 15: No. 6, 63-5(Jun 1972).

On the basis that the characteristics of the action of ionizing radiation on a medium are characterized by the distribution of ionizing (excitation) events P(r), an attempt is made to find this distribution mathematically. Function P(r) is compared with a similar function P(D,r) constructed on the assumption of constancy of the average distance between ionizing events of the medium. It is concluded that the use of functions analogous to P(r) and P(D,r) permits a more complete and simpler characterization of the radiation field by one-three parameters which take into account the LET, dose D, difference in the distribution of ionization of the track cross section, and even the nonrectilinearity of the track. (MHR)

21478 APPROXIMATION OF γ-RAY BUILDUP FACTORS BY GEOMETRICAL PROGRESSION. Harima, Y.; Nishiwaki, Y. (Tokyo Inst. of Tech.). Nucl. Eng. Des.; 23: No. 2, 209-227(1972).

Geometrical progression formulas were derived for the approximation of the γ-ray dose, energy, and energy absorption buildup factors. The approximation formulas have the form $1 + (B - 1)(K^X - 1)/(K - 1)$, where B and K are the two parameters and X is the source-detector distance in the medium in mean free paths. The results of the approximations were in good agreement with the basic data for all the materials used in the basic data, for the energy range of 0.5 to 10 MeV, and for thicknesses up to 20 mean free paths. An approximation using the method for the transmission probability for γ rays obliquely incident on finite slabs was also attempted. Two parameters, B and K, of the geometrical progression form could be represented by monotonic functions of log E, in which the values of the two parameters changed monotonically with the atomic number of the media. Further, the four parameters which were used to represent B and K as linear functions of log E, and the six parameters used to represent B and K as quadratic functions of log E were also observed to change monotonically with the atomic number of the media. Therefore, the values of these parameters can be estimated for any media of different atomic number by interpolation. (auth)

21479 NEW METHOD FOR THE CALCULATION OF THE EMERGENT DISTRIBUTIONS FOR THE ANISOTROPIC SLAB ALBEDO PROBLEM. Shultis, J. K. (Kansas State Univ., Manhattan). J. Comput. Phys.; 11: No. 1, 109-126(Jan 1973).

A method is presented for the calculation of the emergent particle distributions of the albedo problem in one-speed transport theory with arbitrary anisotropic scattering. From a singular eigenfunction expansion of the solution of the albedo problem and the orthogonality properties of these eigenfunctions, a pair of coupled Fredholm integral equations of the second kind are obtained for the reflected and transmitted distributions. These integral equations are readily decoupled, and can be approximated by a set of linear equations from which very accurate numerical solutions are obtained. (auth)

21480 X-RAY SAFETY OF ELECTRON MICROSCOPES. Parsons, F. F.; Phillips, V. A.; Lally, J. S. (Roswell Park Memorial Inst., Buffalo). pp 414-417 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

21481 MEDIUM-ENERGY ION SCATTERING BY SOLID SURFACES. Part 1. Mashkova, E. S.; Molchanov, V. A. (Moscow State Univ.). Radiat. Eff.; 16: No. 3-4, 143-187(Oct 1972).

A review is presented of the experimental results obtained in studying medium-energy ion scattering by solid surfaces. It is confined to the analysis of only one definite interval of primary ion energies – from several keV to several hundreds of keV. This is due to several reasons. First, only this energy interval has been investigated in most detail. Second, only in this interval are the experimental data obtained by various authors in a good agreement. Therefore, well-founded conclusions can be drawn concerning the mechanism of medium-energy ion scattering by solids. Both the experimental technique used by various scientists and experimental data in studying the ion scattering by random solid surfaces are described. The experimental data on the medium-energy ion scattering by crystalline solids are discussed. The theoretical concepts of ion scattering by solids are treated briefly. (auth)

21482 HELIUM ION STOPPING CROSS SECTIONS IN GOLD. Borders, J. A. (Sandia Labs., Albuquerque, NM). Radiat. Eff.; 16: No. 3-4, 253-257(Oct 1972).

The stopping cross section of He ions in gold was measured at incident energies from 0.4 MeV to 1.9 MeV. A backscattering technique was used to measure the energy loss in gold films which had been vacuum evaporated on sapphire substrates. The stopping cross section results are compared with the previous data of Wilcox, Gobeli, and Nakata. Brice's semi-empirical formula has been fit to the data with a resultant root-mean-square percentage deviation of 0.6%. (auth)

21483 ELECTRON-ENERGY LOSS SPECTRA FOR THE FIRST TRANSITION SERIES. Misell, D. L.; Atkins, A. J. (Queen Elizabeth Coll., London). Phil. Mag.; 27: No. 1, 95-106 (Jan 1973).

The energy loss of electrons (incident energy 60 keV) in thin evaporated films of the metals V, Cr, Fe, Co, Ni, and Cu of the first transition series was determined in transmission for the spectral region 3 to 80 ev. The complexity of the spectrum increased along the series as the 3d shell was completed. In V and Cr the main peak (22 to 25 ev) in the spectrum was attributed to a collective excitation (4s + 3d electrons); the positions of similar peaks in the spectra of Fe, Co, Ni, and Cu (18 to 21 ev) were affected by one-electron excitations above or below the plasmon eigenvalue. The loss of about 10 ev observed in all spectra was attributed to the collective excitation of bonding electrons. The structure at higher energy loss values (36 to 65 ev) corresponded to the $M_{2,3}$ x-ray absorption edge; the intense and broad peak 5 ev above this edge in V decreased in intensity along the series and was not evident in the spectrum of Co. (UK)

21484 SPATIAL DISTRIBUTION OF THE IONIZATION INTENSITY NEAR A FLAT RADIOACTIVE SURFACE OF FINITE DIMENSIONS. Rozenkrants, A. S.; Shishkova, I. E. At. Energ. (USSR); 33: No. 6, 1000-1001(Dec 1972). (In Russian).

One of the authors (A. S. R.) had previously developed an expression for computing the spatial distribution of the intensity of ionization near an infinite plane emitting surface. This expression was modified so as to apply to a radioactive surface of finite area with a definite edge effect. A family of lines of equal intensity of ionization near such a bounded surface resulted. (KSW)

21485 THERMAL NEUTRON FLUXES PRODUCED IN A TISSUE-LIKE PHANTOM BY IRRADIATION WITH AN EPICADMIUM NEUTRON BEAM OF FINITE DIAMETER. Ryabukhin, Yu. S.; Ivanov, V. N. (Scientific-Research Inst. of Medical Radiology, Obninsk, USSR). Med. Radiol.; 18: No. 1, 51-56 (Jan 1973). (In Russian).

The thermal neutron fluxes produced in tissue by irradiation with epicadmium neutrons depend on the diameter of the incident beam. A simple semi-empirical formula has been proposed which describes this dependence. The validity of the formula was confirmed in experiments on irradiation of a homogeneous paraffin phantom. The applicability of the formula for a heterogeneous tissue-paraffin phantom is discussed. The study was performed in connection with the development of the neutron capture therapy. (auth)

Radiation Source Calibration and Standardization

Refer also to abstracts 20092, 20153, and 20154.

21486 MULTIWIRE PROPORTIONAL COUNTER TECHNIQUE FOR STANDARDIZATION OF LOW-ENERGY PHOTON SOURCES. Chew, W. M.; McGeorge, J. C.; Fink, R. W. (Georgia Inst. of Tech., Atlanta). Nucl. Instrum. Methods; 106: No. 3, 499-501 (1973).

A wall-less multiwire anticoincidence proportional counter (MWPC) technique is presented which enables emission rates of photon sources below 50 keV to be intercalibrated to better than ±3.5% (2σ statistical, plus linear addition of systematic, error) without knowledge of counting gas cross sections. The difficulties associated with the extension of this method to an absolute standardization technique are discussed. The source is placed external to the Be window of a large volume MWPC, the detection efficiency of which can be varied by changing the gas pressure. For a MWPC, a maximum occurs in the gas counting efficiency with variation of the pressure. If the counting rates of low-energy photons from different sources are maximized by changing the gas pressure from one source to another, then the detection efficiency of the center counter is the same, and its absolute value is

dependent only on the ratio of the two geometrical distances defining the center- and ring-counters. In this way several different sources may be standardized accurately against one or more primary X-ray standards. (auth)

Shielding Calculations and Experiments

Refer also to abstracts 20395, 20783, 20906, and 21920.

21487 (ORNL-TM-4029) SHIELDING OF MANNED SPACE VEHICLES AGAINST GALACTIC COSMIC-RAY PROTONS AND ALPHA PARTICLES. Santoro, R. T.; Alsmiller, R. G. Jr.; Chandler, K. C. (Oak Ridge National Lab., Tenn.). Feb 1973. Contract W-7405-eng-26. 23p. Dep. NTIS.

Calculated results are presented of the absorbed-dose rates and dose-equivalent rates as a function of depth in tissue when galactic cosmic-ray proton and alpha-particle spectra are isotropically incident on a spherical shell shield with a tissue sphere at its center. Aluminum shield thicknesses of 5 and 20 g cm^{-2} are considered. It is found that the dose rates from incident alpha particles are comparable to those from incident protons, and for both protons and alpha particles there is a very appreciable contribution to the dose rates from nuclear-reaction products. (auth)

21488 (ZJE-119) DETERMINATION OF CROSS SECTIONS FOR SOLUTION OF GAMMA RAY TRANSPORT. Valenta, V. (Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Construction Dept.) 1972. 79p. Dep. NTIS (U. S. Sales Only).

The method for determination of group constants for solution of transport of gamma rays in shielding using P_1, P_3, $2P_1$ and S_N approximation, and for determination of sources of electrons originated in consequence of gamma rays. The choice of energy groups and spectrum used for averaging is also discussed. (auth)

21489 TEST RESEARCH ON NEUTRON SHIELDING. Okajima, N.; Yamamoto, M.; Mizushina, T. (Taisei Construction Co. Ltd., Tokyo). Taisei Kensetsu Gijutsu Kenkyusho-Ho; No. 4, 21-36(Oct 1971). (In Japanese).

In order to obtain basic data for design of radiation shielding required for accelerator establishments, shielding performance and induced-radiation tests for shielding materials were carried out, and actual conditions in existing establishments were researched. As for neutron energy, 500 keV, 1, 2, 5, 14.1 and 18 MeV were employed. As the shielding materials, lead, iron, heavy concrete, ordinary concrete, water, paraffin and borated paraffin were used. Under 1 MeV, the attenuation effect of hydric materials is great, but at high energy, that of iron increases. Using a REM/N rem counter, the dose equivalent ratio of radiation scattered by the shielding materials was determined. The induced radiation of aluminum, copper, europium, lead, mortar, heavy mortar, borated paraffin and phantom, irradiated by 14.1 MeV neutrons, was measured with a NaI(Tl) scintillation counter. For example, specific radiation of manganese in an iron plate decreases exponentially in relation to depth, hence, distribution of neutrons above 7 MeV in iron can be obtained. Attenuation effect of materials concerning neutrons and γ rays emitted from Ra-Be reaction was studied. Hydric materials have good attenuation effect for the neutrons, but poor for the γ rays. Inversely, lead is good for the γ rays but poor for the neutrons. Iron is good for both radiations. Based on the above test results, a widely used calculation method for radiation shielding was investigated. (Japan)

PHYSICS (SOLID-STATE)

21490 (BLG-467, pp 3.1-68) BASIC AND EXPLORATORY RESEARCH.

In this chapter, brief summaries of activities or results are given in the following sections: (1) Solid-State Physics (radiation damage, structural defects, physical properties, crystallography and magnetic structures for various solid materials; (2) Nuclear Physics (reactor physics calculations, cross-section standards, some reactor irradiations, fission physics and chemistry nuclear spectroscopy, and theoretical calculations of nuclear properties); (3) Radiobiology (acute, late, and genetic effects of radiation; integration, replication, and biological effects of foreign DNA administered to different organisms; and radioactive pollution of the environment); and (4) Exploratory Research (in the various disciplines). Data are given only in a very few cases, and most of the material has been published elsewhere in expanded form. (LMT)

Radiation Effects

Refer also to abstracts 19641, 20388, and 20716.

21491 (AD-749689) NEUTRON INDUCED DAMAGE IN p- AND n-TYPE PbS SINGLE CRYSTAL FILMS. Culpepper, R. M. (Naval Ordnance Lab., White Oak, Md). 4 Aug 1972. 193p. (NOLTR-72-119). NTIS.

The Hall coefficient, resistivity, and charge carrier mobility of epitaxial films of n- and p-type PbS having carrier concentrations between 10^{17} and 10^{18}/cm^3 were measured at 4.5 and 300°K before and after successive neutron irradiations. The irradiations in the National Bureau of Standards reactor at Gaithersburg, Maryland were in four steps of approximately 3.5×10^{16} n/cm^2 each. The variation of the Hall coefficient with irradiation level was used to calculate the carrier removal rate. Information about radiation-induced localized energy states in the energy band gap was obtained from change of the Hall coefficient with temperature. The variation of mobility with temperature provided information about the defect scattering mechanism. Cascade displacement theory was applied to PbS to predict the concentrations of Pb and S displacements. This information in conjunction with the carrier removal rate gave the number of removals per defect pair. (auth)

21492 (COO-1057-57) BEHAVIOR OF ROCK SALT LATTICES UNDER THE INFLUENCE OF ENERGY LOSS AND POSITIVE ELECTRICALLY CHARGED FAST PARTICLES. Dreschhoff, G. (Technische Universitaet, Brunswick (West Germany). [Kansas Univ., Lawrence (USA). Radiation Physics Lab.]). 1972. Contract AT(11-1)-1057. 95p. (In German). Dep. NTIS.

Thesis. Submitted to Univ., Brunswick.

Rock salt crystals (NaCl) were bombarded with 1- and 2-MeV monoenergetic protons from a Van de Graaff accelerator at low temperature (77°K) and at room temperature. In the case of low temperatures, there was a layer development within the part of the crystal penetrated by the particle. The layers are essentially characterized by three zones: (1) intensive coloring of the crystal (50 μ) following the energy loss of the particle to the crystal lattice principally in the form of inelastic collisions; (2) a bleached zone of 2 μ following; and (3) a third colored zone (2 μ) within which the particle range lies. The cause of each of the zones is discussed. Some comparisons are made with radiation effects of other particles and γ radiation. (56 references) (JSR)

21493 (COO-1629-37) THERMAL MEASUREMENTS ON SOLIDS BELOW 1 K. Progress Report No. 7. Weinstock, H. (Illinois Inst. of Tech., Chicago. Dept. of Physics). Feb 1973. Contract AT(11-1)-1629. 21p. Dep. NTIS.

The research summarized include: thermal conductivity of neutron- and electron-irradiated MgO, thermal conductivity of Pb films, electric conductivity of carbon films, thermal and electric conductivities of neutron-damaged pyrolytic graphite, thermal and electric conductivities of Kondo alloys (Cu and Cu containing Cr or Fe), specific heat of $UO_2Rb(NO_3)_3$, specific heat of $(CH_3)_4NMnCl_3$. (DLC)

21494 (ORO-4049-3) RADIATION DAMAGE IN OPTICALLY TRANSPARENT MATERIALS (ZIRCON). Progress report, February 1, 1972-January 31, 1973. Thorpe, A. N.; Senftle, F. E.; Tsang, T.; Briggs, C. (Howard Univ., Washington, D. C.). [nd]. Contract AT(40-1)-4049. 14p. Dep. NTIS.

Near-infrared, electron microscopic, ESR, and magnetic susceptibility measurements have been made and are reported. (DLC)

21495 YADERNO-KHIMICHESKIE YAVLENIYA V TVERDYKH TELAKH. (Nuclear-Chemical Phenomena in Solids). Tbilisi, USSR; Izdatel'stov Metsniereba (1972). 122p.

The emphasis of the 16 papers is on tritium in LiF, irradiated SiO_2, and tritium-ethane reactions. Separate abstracts were prepared for 15 of the papers. The remaining paper is on a regulator of small gas flows for gas chromatography. (DLC)

For abstracts of individual papers see: 19610-19612, 19661, 21496-21504, 21881, and 21882.

21496 TRITIUM IN LiF CRYSTALS. Tsetskhladze, T. V.; Natsvlishvili, G. I.; Timofeeva, E. E.; Cherkezishvili, L. I. pp 1-13 of Yaderno-Khimicheskie Yavleniya v Tverdykh Telakh. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian)

The release of tritium from powders and single crystals of LiF irradiated by neutrons at different temperatures was studied. A close relation between the process of tritium release and the defect structure of a crystal was found, hence the tritium diffusion has the character of damage diffusion. The tritium diffusion coefficient depends on irradiation temperature and decreases with the temperature drop from 200°C to -163°C. The tritium diffusion is accompanied by formation of point defect clusters, in particular, gas bubbles. Using the electron microscopic technique and crystal-shear decoration with gold and carbon, one may observe gas pores containing the products of the reaction $^6Li(n,\alpha)T$ and radiolysis of LiF. (auth)

21497 GAS PORES OF PRODUCTS OF NUCLEAR REACTION AND RADIOLYSIS IN LiF. Tsetskhladze, T. V.; Natsvlishvili, G. I.; Cherkezishvili, L. I. pp 14-27 of Yaderno-Khimicheskie Yavleniya v Tverdykh Telakh. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian).

Radiation damage of LiF crystals was studied. The crystals were irradiated by fast neutrons and gamma radiation or by slow neutrons, fast neutrons, and gamma radiation at -163°C, 20°C, and 200°C at doses of 10^{16}, 10^{17}, and 10^{18} n cm^{-2} and then were isothermally annealed at different temperatures. In crystals, in which the $^6Li(n,\alpha)$ reaction took place, high-temperature annealing followed by decoration of crystal shear with gold and carbon, resulted in electron-active centers in the form of round spots of different diameter. The absence of such regions in crystals irradiated only with fast neutrons and gamma radiation and also the peculiarity of their formation and growth indicates that they are gas bubbles containing tritium, helium, and fluorine formed under irradiation and flowing into the pores during annealing. The probability of gas pore formation depends on the irradiation temperature, thermal neutron dose, and also on temperature and time of postradiation thermal annealing. (auth)

21498 TRITIUM DIFFUSION FROM LiF CRYSTALS WITH DIFFERENT VACANCY CONTENT. Tsetskhladze, T. V.; Tsitsishvili, V. G. pp 28-33 of Yaderno-Khimicheskie Yavleniya v Tverdykh Telakh. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian).

The rate of tritium release from LiF crystals was measured with varying different contents of vacancies introduced by quenching at high temperatures. The ionic conductivity of specimens was also measured. The diffusion coefficient and ionic conductivity of specimens of quenched crystals decreased. One assumes that, in the presence of a great number of vacancies in LiF, a complex defect is formed in which T is bound with a vacancy. The mobility and diffusion coefficient of this defect are smaller than these of a point defect. (auth)

21499 ANNEALING OF PARAMAGNETIC DEFECTS GENERATED IN SILICON OXIDE IRRADIATED WITH (n,γ) RADIATION IN THE NUCLEAR REACTOR. Nadirashvili, L. Sh.; Berulava, B. G.; Tsetskhladze, T. V. pp 40-47 of Yaderno Khimicheskie Yavleniya v Tverdykh Telakh. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian).

ESR techniques were used to study thermal annealing (77 to 400°K) of defects generated in the specimens of amorphous silicon oxide irradiated in the temperature range from 90 to 260°K by reactor radiation. The defects with $g = 2.0006$ were stable with respect to thermal annealing up to 400°K and higher, while the so called "surface defects" with $g = 2.0045$ and $g = 2.0080$ were annealed at the temperature of 300°K. The character of thermal annealing of the latter was explained by the simultaneous course of two competing processes: disappearance of defects due to thermal annealing and their formation due to diffusion from the volume to the surface. (auth)

21500 ESR SPECTRA OF SILICON OXIDE IRRADIATED WITH DIFFERENT GASES. Nadirashvili, L. Sh.; Berulava, B. G.; Tsetskhladze, T. V. pp 48-54 of Yaderno Khimicheskie Yavleniya v Tverdykh Telakh. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian).

ESR was used to study amorphous silicon oxide specimens irradiated with different gases at 90°K by reactor (n,γ) radiation. ESR spectra in the irradiated-in-vacuum specimens showed components with g = 2.0006 and 2.0094 with a total linewidth of 90 Oe. Absorption lines were recorded with g = 2.0045 and 2.0080 for specimens irradiated with oxygen or irradiated in vacuum, but with oxygen added after irradiation. On irradiation of silicon oxide with ethane or hydrogen, most centers with g = 2.0045 and g = 2.0080 disappear. That indicates their acceptor nature and their location on the silicon oxide surface in accessible places. (auth)

21501 ESR SPECTRUM OF ATOMIC HYDROGEN IN SILICON OXIDE IRRADIATED IN THE NUCLEAR REACTOR. Berulava, B. G.; Tsetskhladze, T. V.; Nadirashvili, L. Sh. pp 55-58 of Yaderno-Khimicheskie Yavleniya v Tverdykh Telakh. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian).

The ESR spectrum was studied for atomic hydrogen stabilized in amorphous silicon oxide irradiated at 90°K by (n,γ) radiation in the reactor. The observed doublet has an asymmetric shape. The character of the doublet line saturation indicates the existence of centers of hydrogen atom stabilized on the surface and a subsurface layer of irradiated silicon oxide. The ratio of the components of the ESR spectrum corresponding to centers in the subsurface and surface layers is 1:5. The time of spin–lattice relaxation in specimens of silicon oxide irradiated at 77°K by n, γ radiation of the reactor is 10^{-5} while for irradiation by the same dose of γ radiation, it is an order of magnitude higher. (auth)

21502 QUENCHING OF ABSORPTION CENTERS INDUCED BY RADIATION ON THE SURFACE OF SILICON OXIDE. Tsetskhladze, T. V.; Chikhladze, L. A. pp 59-65 of Yaderno-Khimicheskie Yavleniya v Tverdykh Telakh. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian).

Ethane adsorption on silicon oxide surface was studied. Silicon oxide was irradiated with gamma radiation at 50 and –196°C. Adsorption measurements were then carried out at room temperature. The pressure range was 10^{-1} to 10^{-4} torr. Irradiation of silicon oxide with a dose of 2 Mrad at 50°C leads to a considerable decrease of adsorption capacity in comparison with nonirradiated samples; at 140 millitorr, the difference between the adsorbed amounts was 30%. After irradiation at –196°C, the adsorption activity is not changed. The observed disappearance of active centers on irradiation was the result of their interaction with radiation-generated defects. Diffusion of the latter was accelerated in the field of gamma radiation. (auth)

21503 ETHANE ADSORPTION ON AN IRRADIATED ZEOLITE NaA. Tsetskhladze, T. V.; Chikhladze, L. A. pp 100-105 of Yaderno-Khimicheskie Yavleniya v Tverdykh Telakh. Tbilishi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian)

The influence of gamma and mixed (n,γ) radiation on the adsorption of ethane on the zeolite NaA was studied. The irradiation temperature was 50°C. The dose of the gamma irradiation was 1.8 Mrad, of (n,γ) 30 Mrad. After gamma irradiation, the adsorption activity of a zeolite increased 45% and under the action of (n,γ) radiation 60% in the range of the ethane pressure of the order of several hundred torrs. (auth)

21504 MASS SPECTRUM OF THE GAS RELEASED FROM LiF CRYSTALS IRRADIATED IN THE REACTOR. Kirtadze, M. G.; Sakvarelidze, V. S. pp 111-114 of Yaderno Khimicheskie Yavleniya v Tverdykh Telakh. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian)

Mass spectrum of the gas released from LiF crystals, irradiated at ambient reactor temperatures by mixed reactor radiation (thermal neutron flux of $10^{18} n \cdot cm^{-2}$) was measured. To release the formed gases, the crystals were annealed after irradiation at 700°C for 10 hours. The qualitative composition of the gases was determined: there is a large amount of light hydrogen and tritium, helium and hydrogen fluoride in amounts smaller by four orders of magnitude. (auth)

21505 DIRECTIONAL EFFECT FOR 1-MeV PROTONS IN A SILICON SINGLE CRYSTAL. Fiderkiewicz, A. (Inst. of Nuclear Physics, Swierk, Poland); Golanski, A. Nukleonika; 17: No. 7-8, 369-370(1972). (In Polish).

The scattering of 1-MeV protons by a silicon single crystal was studied with the Krakow cyclotron. The beam was collimated to 0.1°, aligning the Si single crystal with its ⟨111⟩ direction parallel to the proton beam. The scattered protons were detected at 165° and the effect of rotating the crystal 30′ from the ⟨111⟩ direction was investigated. The experiment was carried out as part of a project aimed at the study of effect of impurities implanted in semiconductors. The results are presented in graphical form. (TTT)

21506 INFLUENCE OF RADIATION ON THE ABSOLUTE THERMAL EMF OF METALS AND ALLOYS. Adamenko, A. A.; Dekhtyar, I. Ya.; Shalaev, A. M. (Inst. of Metal Physics, Kiev). Fiz. Metal. Metalloved.; 34: No. 3, 464-469(Sep 1972). (In Russian).

A phenomenological description of the changes in thermal emf of metals during irradiation is given. Experimental results are tabulated for metals and alloys over the temperature range 77 to 300°K and fluxes of thermal neutrons, fast neutrons, 6.8-MeV protons, 13.6-MeV deuterons, and 27-MeV α particles. The materials studied include Mo, Cu, Fe, Au, Pt, W, Re, alumel, chromel, and constantan. The effects of annealing Mo and W at 300°C after exposure to protons and deuterons are described. (KSW)

21507 SHALLOW DONOR FORMATION IN Si PRODUCED BY PROTON BOMBARDMENT. Ohmura, Y.; Zohta, Y.; Kanazawa, M. (Tokyo Shibaura Electric Co., Ltd., Kawasaki, Japan). Phys. Status Solidi (a); 15: No. 1, 93-98(16 Jan 1973).

Shallow donors are created in Si by protons, H_2^+, and H_3^+ bombardment at room temperature followed by annealing above 300°C. The electron concentration profiles due to the shallow donors in the bombarded n-type region of the p^+–n junction are determined by the Copeland method. The depth of the concentration peaks is 1 μm for every 100 kV for several hundred kV proton accelerating voltage, and a half and a third of the depth due to protons for H_2^+ and H_3^+ ions, respectively. These shallow donors disappear as the annealing temperature exceeds 700°C. For samples, bombarded at 300°K but not annealed, only deep electron traps are observed. Most traps are annealed out above 300°C, by which the shallow donors emerge. (auth)

21508 RADIATION-INDUCED PARAMAGNETIC DEFECT CENTERS IN SODIUM FLUOROBORATE SINGLE CRYSTALS. Patten, F. W. (Naval Research Lab., Washington, DC). Chem. Phys. Lett.; 18: No. 1, 112-114(1 Jan 1973).

Two radiation-induced defect centers, F^0 and BF_3^-, were identified in $NaBF_4$ single crystals. EPR data are presented for their characterization. (auth)

21509 POST IRRADIATION RECOVERY OF IRRADIATION DAMAGE. Dollins, C. C. (Bettis Atomic Power Lab., Pittsburgh). Radiat. Eff.; 16: No. 3-4, 271-280(Oct 1972).

During irradiation, fast neutrons produce regions depleted of atoms. It is believed that these regions are responsible for most of the hardening observed after neutron irradiation. The dissolution of the depleted zones during a post-irradiation anneal and the subsequent recovery of the yield strength are discussed. The zones dissolve by emitting vacancies and therefore have an activation energy made up of the sum of the vacancy binding energy to the zone and the vacancy migration energy. The resultant activation energy increases with recovery. For zirconium-base alloys, it was found that the activation energy varies from 49,700 cal/mole at 10% recovery to 61,600 cal/mole at 50% recovery. Experimental data available indicate a similar increase in the activation energy with recovery. (auth)

21510 TEMPERATURE DEPENDENCE OF GAMMA IRRADIATION DAMAGE IN SILICON. Kao, K. C.; Sill, R. J. (Manitoba Univ., Winnipeg, Canada). Radiat. Eff.; 16: No. 3-4, 281-286 (Oct 1972).

New results on the current–voltage characteristics of low- and high-resistivity silicon before and after gamma irradiation at 38°C and –196°C are reported. (auth)

21511 HIGH VOLTAGE ELECTRON MICROSCOPY OBSERVATIONS OF THE GROWTH OF INTERSTITIAL LOOPS IN AN IRON–NITROGEN ALLOY. Williams, K. R.; Fisher, S. B. (Central Electricity Centrating Board, Berkeley, Eng.). Radiat. Eff.; 16: No. 3-4, 259-266(Oct 1972).

Precipitation of interstitial loops and iron nitride in an iron–nitrogen alloy was examined in the temperature range 30 to 300°C using a high-voltage electron microscope. The use of thick foils enabled the direct observation of iron nitride precipitation. Observations confirm both theoretical and indirect experimental studies of the hardening behavior of α-iron alloys following neutron irradiation. Many of the interstitial loops are of {100} type. In certain cases, the unfaulted $\frac{1}{2}\{110\}$ type are observed. The precipitation of iron nitride at the edge of the loop effectively prevents further growth, thus inhibiting void swelling. (auth)

21512 ANALYTICAL DETERMINATION OF THE CRITICAL ANGLE AND CRITICAL DISTANCE OF APPROACH OF PARTICLES CHANNELED ALONG PRIMITIVE AND NONPRIMITIVE ATOMIC ROWS. Varelas, C.; Sizmann, R. (Univ., Munich). Radiat. Eff.; 16: No. 3-4, 211-222(Oct 1972).

A parallel beam of charged projectiles, reflected by a static atomic row inevitably exhibits a spread in outgoing transverse energy. However, above a certain critical distance of approach, ρ_c, the dispersion of the transverse energy of the outgoing particles around $E\psi^2_{in}$ (transverse energy of entering particles) turns out to become exceedingly small. In the present investigation, analytical formulae to determine ρ_c and the corresponding ψ_c are derived for axial channeling along static primitive rows and rows with a basis consisting of two different equidistant atoms, two equal but not equidistant atoms, or two different and not equidistant atoms per periodic length. A plot for a convenient evaluation of ψ_c and ρ_c is given. Previous equations for ψ_c and ρ_c and the present results are examined and compared with computer calculations. The reliability of the new formulae is demonstrated over four orders of magnitude of particle energy. A comparison with almost all available experimental data on critical axial channeling angles exhibits the relevance of the present analytical solutions. (auth)

21513 STRUCTURAL INHIBITION OF FERROELECTRIC SWITCHING IN TRIGLYCINE SULPHATE. II. X-irradiation/field treatment. Bye, K. L.; Keve, E. T. (Mullard Research Labs., Redhill, Eng.). Ferroelectrics; 4: No. 2, 87-95(Aug 1972).

The changes induced in some properties of triglycine sulphate (TGS) single crystals by x irradiation in the presence of an external electric field are found to be beneficial to the pyroelectric applications of this material. The variations of dielectric and pyroelectric properties are investigated as a function of radiation dose. Optimum properties are found after irradiation sufficient to cause the development of a self-bias of a few kV/cm on the crystal which keeps it in a single-domain state. This effect is accompanied by an increase in the pyroelectric coefficient and a decrease in the dielectric constant at room temperature. Properties comparable to those recently reported for TGS crystals containing L-alanine are thus obtained. The annealing effects of elevated temperatures and electric fields on the irradiation-induced self bias are documented. The relevance of the present results to applications of TGS and to the recent structural studies of irradiation/field-treated TGS crystals are discussed. (auth)

21514 HIGH-RESOLUTION ELECTRON MICROSCOPY INVESTIGATION OF RADIATION PRODUCED DEFECTS IN COPPER AND COPPER–ALUMINUM CRYSTALS. Howe, L. M.; Rainville, M. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Radiat. Eff.; 16: No. 3-4, 203-209(Oct 1972).

The investigation was undertaken in order to study the strain field of small defects (~10 to 75 Å diameter) produced in Cu and Cu–16 at. % Al crystals by neutron irradiation and by bombardment with 40-keV Cu^+ ions. In addition to bright and dark field observations at electron optical magnifications of 250,000 to 425,000×, lattice fringe images were obtained in the vicinity of the radiation-produced defects by combining the transmitted beam with one of the diffracted beams. It was found that some of the defects had a principal strain component along only one ⟨111⟩, whereas other defects had a more complex strain field with strain components along more than one direction. For those defects with a principal strain component along only one ⟨111⟩, the localized defect concentration in a collision cascade may be sufficiently high for the spontaneous formation of a Frank dislocation loop to occur. In those cases where the strain field of the defect is more complex, there may only be subregions within a single collision cascade where the localized defect concentration is high enough to produce sufficient strain contrast to be visible. Spontaneous loop formation may occur in some of these subregions but not in others. (auth)

21515 STUDY OF THE REACTIONS AND LUMINESCENCE OF AROMATIC COMPOUNDS DISSOLVED IN PHOTOINERT ORGANIC SOLIDS INDUCED BY PHOTON AND HIGH-ENERGY IRRADIATION. Morantz, D. J.; Bilen, C. S. (London Coll. of Printing). pp 525-534 of Reactivity of Solids. Anderson, J. S. (ed.). London; Chapman and Hall, Ltd. (1972).

From 7th International Symposium on the Reactivity of Solids; Bristol, United Kingdom of Great Britain and Northern Ireland (UK) (17 Jul 1972). See CONF-720703–.

Effects of x-ray and uv irradiation on the photoluminescence of certain aromatic impurities, dissolved in solid transparent organic substrates, are studied. A new and intense room temperature phosphorescence is induced. Results, for acenaphthene and triphenylene as examples of impurities dissolved in polymethylmethacrylate glass and in cyclododecane single crystals, are given in detail and discussed. Effects are cumulative and persist for times depending on irradiation conditions. Results are explained in terms of new energy states induced in the substrate. The nature of these states, as traps or defects, and also their interaction with impurity states are discussed. (auth).

21516 FORMATION OF DISLOCATION CHANNELS IN NEUTRON-IRRADIATED MOLYBDENUM. Mahajan, S. (Bell Telephone Labs., Murray Hill, NJ). pp 672-673 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

21517 DEPTH DISTRIBUTION OF DEFECT CLUSTERS IN ELECTRON-IRRADIATED ALUMINUM FILMS. Rao, P. (Cornell Univ., Ithaca, NY). pp 684-685 of Proceedings of the Thirtieth Annual Meeting of the Electron Microscopy Society of America and First Pacific Regional Conference on Electron Microscopy. Arceneaux, C. J. (ed.). Baton Rouge, LA; Claitor's Book Store (1972).

From 30th annual meeting and 1st Pacific regional conference of the Electron Microscopy Society of America; Los Angeles, CA (14 Aug 1972). See CONF-720842.

21518 DEFORMATION AND VOID GROWTH IN IRRADIATED METALS UNDER STRESS. Wolfer, W. G. (Westinghouse Advanced Reactor Div., Madison, PA); Straalsund, J. L. AT(45-1)-2170. Scr. Met.; 7: No. 2, 161-172(Feb 1973).

The problem of void growth under stress is solved by deriving the boundary conditions for the vacancy and interstitial concentrations at the sinks and solving approximately the diffusion equations for the point defects. The creep deformation may be related to the stress-affected swelling. Only effects that are linear in the stress are treated. The concept of "chemical stress" is considered and found to be applicable only to different states of local thermodynamic equilibrium. (DLC)

21519 EFFECT OF PRIMARY RECRYSTALLIZATION ON THE RECOVERY STATE V OF NEUTRON-IRRADIATED COPPER. Papathanassopoulos, K.; Chountas, K.; Olympios, E.; Andronikos, P. (Democritus Nuclear Research Center, Athens). Radiat. Eff.; 16: No. 3-4, 287-289(Oct 1972).

Measurements are reported of the recovery spectra of the electrical resistivity after neutron irradiation at 78°K of previously cold-worked copper specimens at room temperature and compared with well annealed specimens after neutron irradiation. The aim of the experiments was to examine the interaction between interstitial clusters created by the neutron irradiation at 78°K and the grain boundary migration during the primary recrystallization. It is observed that Stage V (560°K) disappears from the samples that are deformed before irradiation. An explanation for this result is offered. (UK)

21520 OPTICAL REFLECTION STUDIES OF LATTICE DISORDER IN IODINE IMPLANTED CdS. Hutchby, J. A. (Langley Research Center, Langley Station, VA). Radiat. Eff.; 16: No. 3-4, 189-192(Oct 1972).

Optical reflectivity spectra (3.45 to 5.90 eV) of CdS implanted with 40-keV I^+ are presented for doses between 5×10^{13} and 1×10^{16} ions/cm^2 and for isochronal anneals up to 550°C. Typical peaks (E_1: A, B) present in crystalline CdS decrease with increasing dose until they are no longer resolvable; however, a prominent saturation observed in Si and somewhat in GaAs is not found for doses up to 1×10^{16} ions/cm^2. Correlation with similar results obtained from the Rutherford scattering technique suggests the reflection variations are damage related and verifies previous results that an observable amorphous layer is not formed. Annealing tends to increase the peaks with complete restoration occurring for doses 7×10^{14} ions/cm^2 annealed at 500°C. (auth)

21521 EXISTENCE OF TWO INTERSTITIAL SPECIES IN PLATINUM. Kachoukh, N.; Daoud, M.; Lucasson, A.; Lucasson, P. (Centre National de la Recherche Scientifique, Orsay, France). Radiat. Eff.; 16: No. 3-4, 193-196(Oct 1972).

The electrical resistivity increases in platinum samples electron-irradiated at 140°K after slow quenches were measured as functions of the incident particle flux. The significance of plateaus found in the production curves is discussed with regard to the One- and the Two-Interstitial Models in fcc metals. (auth)

21522 APPARATUS FOR THE STUDY OF LOW-ENERGY ION TRAPPING AND GAS RELEASE IN SOLID TARGETS. Armour, D. G. (Univ. of Salford, Eng.); Grant, W. A.; Cavaleru, A. O. R.; Morley, C. M. Vacuum; 22: No. 10, 457-462(Oct 1972).

Experimental apparatus was constructed to study the phenomena associated with the penetration and entrapment of rare gas atoms in solid targets following bombardment with low-energy (50 eV to 3 keV) monoenergetic ion beams. In this apparatus, ions strike a solid target and a fraction becomes entrapped. The fraction trapped is subsequently evaluated by heating the target in a well-defined manner, the evolved gas being recorded with a mass spectrometer. Additionally, using this thermal desorption technique, the rate of release of gas as a function of temperature was continuously monitored in order to investigate the details of the mechanisms of ion entrapment and subsequent thermal motion. In order to provide facilities for the study of a wide range of target materials, a programmable electron-bombardment-heating system was incorporated into the apparatus. The present paper is concerned primarily with a description of the theoretical and practical factors which influenced the design of the apparatus which is completely compatible with ultrahigh vacuum requirements, and includes the results of preliminary measurements in uranium dioxide, single-crystal copper (100), and pyrex glass targets. (auth)

Physical Properties

Refer also to abstracts 19908, 20201, 20230, 20520, 20707, 20958, 20990, and 21493.

21523 (AD-748429) MAGNETIC STRUCTURE DETERMINATION OF RARE EARTH-COBALT-IRON SYSTEMS, RFe(x)Co(5-x) BY NEUTRON DIFFRACTION. Report No. 1 (annual), 15 March 1971-15 March 1972. James, W. J.; Lemaire, R. (Missouri Univ., Rolla). Aug 1972. Contract F33615-71-C-1332. 74p. (AFML-TR-72-153). NTIS.

Hexagonal intermetallic compounds close to R_2M_{17} stoichiometry in the Lu-Fe, Th-Ni, Y-Ni, and Er-Co systems were studied by single-crystal x-ray techniques. Additional neutron diffraction studies were made of the Lu-Fe compound. The thermal variation of lattice parameters of rare earth-transition metal intermetallic compounds rich in Fe, Co, or Ni in the temperature range 25-900°K was studied. Lattice parameter measurements were made on $Y_xLa_{1-x}Fe_yCo_{5-y}$ alloys. Neutron diffraction studies of $LuFe_{9.5}$ and $HoFe_3$ were made to determine their magnetic structure. The ferromagnetic behavior of $LuFe_{9.5}$ up to 100°K was confirmed. (auth)

21524 (AECL-4355) ELECTRON DIFFRACTION PATTERNS FOR H.C.P. α-ZIRCONIUM. Carpenter, G. J. C.; Watters, J. F. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Nov 1972. 15p. Dep. NTIS (U. S. Sales Only). AECL $0.50.

Data are presented to facilitate the identification of electron diffraction patterns from α-zirconium. Single-crystal spot patterns can be conveniently indexed by comparison with a series of standard patterns produced by plotting planes of the reciprocal lattice. For detailed contrast experiments or more accurate orientation analysis, schematic Kikuchi maps are provided. (auth)

21525 (ORNL-4811, pp 13-18) INTERACTION OF RADIATION WITH LIQUIDS AND SOLIDS. Arakawa, E. T.; Birkhoff, R. D.; Callcott, T. A. Sep 1972.

In Health Physics Division annual progress report for period ending July 31, 1972.

Brief outlines are given on the following research areas during this period; (1) optical properties of K between 4 and 10.7 eV, (2) optical properties of glassy carbon from 0 to 82 eV, (3) a slope method for determining extinction coefficients, (4) work function changes during oxygen chemisorption on fresh magnesium surfaces, and (5) a technique for revitalization of vacuum uv diffraction gratings. (MOW)

21526 RELATIVISTIC LOW ENERGY ELECTRON DIFFRACTION FROM DELTIUM. Feder, R. (Univ. of Cape Town). pp O.1-8 of Fifth Annual Seminar on Theoretical Physics. Pretoria; Atomic Energy Board (1970).

From 5th annual seminar on theoretical physics; Pretoria, South Africa (13 Jul 1970). See CONF-700728.

In view of the considerable amount of computational labor required by LEED theories, which use a (more or less) realistic crystal potential, it seemed useful to investigate relativistic effects for a potential model for which an exact solution on the basis of Dirac's equation can be obtained in principle analytically, in practice with a comparatively small computational effort. The model used and referred to as "deltium" is a simple cubic lattice (with lattice constant a) of attractive δ-potentials of strength v_0, which is infinite in two dimensions and extends from o to ma in the third: $v_c(x) = -v_0 \Sigma_n \delta(x - na)$, $n = (n_1, n_2, n_3)^T$; v_0 can be complex to incorporate inelastic scattering. (auth)

21527 HIGH-TEMPERATURE SPECIFIC ELECTRIC RESISTIVITY OF RHENIUM AND MOLYBDENUM-RHENIUM ALLOYS. Peletskii, V. E.; Druzhinin, V. P. (Inst. of High Temperatures, Moscow). High Temp. (USSR) (Engl. Transl.); 10: No. 3, 584-585(1972).

Translated from Teplofiz. Vys. Temp.; 10: No. 3, 652-653 (1972).

The temperature dependence of specific electrical resistivity was investigated using the compensated dc technique and electron specimen heating. Cylindrical test specimens of diameter 8 to 10 mm and length 60 mm were used. The temperature distribution along the specimen was measured with an OMP-054 optical brightness pyrometer; a cylindrical blackbody cavity of 0.8 mm diameter and 5 to 6 mm depth was formed in the specimen. From ambient temperature to 1200 deg K the specimens were heated in a resistance furnace having molybdenum heaters, and their temperature was measured with platinum—platinum-rhodium thermocouples. (auth)

21528 PSEUDOPOTENTIAL CALCULATIONS OF THE ELECTRONIC STRUCTURE OF A TRANSITION-METAL COMPOUND: NIOBIUM NITRIDE. Fong, C. Y. (Univ. of California, Davis); Cohen, Marvin L. Phys. Rev., B; 6: No. 10, 3633-7(15 Nov 1972).

The electronic band structure, density of states, and $\epsilon_2(\omega)$, the imaginary part of the dielectric constant, are calculated for niobium nitride using the empirical-pseudopotential method. The results are compared with non-self-consistent and with the self-consistent augmented-plane-wave calculations. A discussion of the Fermi surface is included. (auth)

21529 COMMENT ON PSEUDOPOTENTIALS FOR TRANSITION METALS. Allen, P. B. (State Univ. of New York, Stony Brook). Phys. Rev., B; 6: No. 10, 4069-71(15 Nov 1972).

The Fong-Cohen empirical pseudopotentials for Cu and Nb are shown to be close approximations to a member of a family of pseudopotentials which also includes Harrison's first-principle pseudopotentials for transition metals. The lack of energy dependence in the Fong-Cohen potential is discussed and partly explained. (auth)

21530 PRESSURE EFFECT ON THE FERMI SURFACE OF MOLYBDENUM, TUNGSTEN, AND RHENIUM. Svechkarev, I. V.; Piuzhnikov, V. B. (Physical-Technical Inst. of Low Temperatures, Kharkov). Phys. Status Solidi (b); 55: No. 1, 315-320 (1 Jan 1973).

Employing the de Haas-van Alphen effect, the behavior of small cross sections of the Fermi surface under pressure was studied on Mo, W, and Re. The results are discussed in terms of a simple empirical model for spectrum changes under pressure. The model also involves the deformation of d band and its shift relative to the s-p band. The possibility is shown of obtaining quantitative information on the behavior under pressure of the fundamental parameters of the transition metal energy spectra on the basis of studying small cross sections of the Fermi surface. (auth)

21531 HYPERFINE FIELDS IN FERROMAGNETIC RARE-EARTH ALLOYS. Guimaraes, A. P.; Gomes, A. A. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janiero). Phys. Status Solidi (b); 55: No. 1, 361-369(1 Jan 1973).

The hyperfine fields in ferromagnetic rare-earth alloys are discussed, assuming that the impurity concentration affects only the transferred hyperfine field, the effects on the band susceptibility being assumed to be small. The slope of the hyperfine field versus average spin in these alloys can be analyzed in terms of this model; intermetallic systems like $Gd_xY_{1-x}Al_2$ are also considered. It is observed that the dominant contribution to the magnetization is due to d electrons, whereas the hyperfine field slope arises mostly from the interaction with the s electrons. (auth)

21532 MECHANISM OF ELECTRICAL CONDUCTIVITY IN BORON AT LOW TEMPERATURES. Zareba, A. (Inst. of Physics, Warsaw). Phys. Status Solidi (a); 15: No. 1, K23-K27 (16 Jan 1973).

Photoexcitation at 1.5 eV was used to produce "frozen-in" photoconductivity in B. Transport property measurements showed a decrease of activation energy with photocarrier concentration. Results are interpreted in terms of valence localized (VL) states and monoenergetic special valence localized (SVL) states. At low temperatures, two components are observed owing to transfers between VL states and SVL states, respectively. The hopping process may be described as a thermal activation of a hole from a deeper VL state to a SVL state, followed by a transfer to a neighbor SVL state and a subsequent fall into a VL state. The β-rhombohedral form of B may be regarded as an amorphous-like semiconductor. (DLC)

21533 FIELD EFFECT IN β-RHOMBOHEDRAL BORON. Szadkowski, A.; Zareba, A. (Inst. of Physics, Warsaw). Phys. Status Solidi (a); 15: No. 1, K29-K31(16 Jan 1973).

The field effect was used to determine some parameters of the thermally activated hopping type of conductivity. The B sample plays the role of a condensor plate in the experimental arrangement; the relaxation of the field effect is very slow, and only one pulse is observed. Holes were found to dominate in the conductivity, and the effective mobility at 273°K was determined to be 7×10^{-4} cm^2/V-s. The total number of holes was measured as a function of temperature; below 225°K, it reaches a constant value, corresponding to a surface concentration of carriers of ~10^{13} cm^{-2}. (DLC)

21534 MAGNETIC SUSCEPTIBILITY OF THE ALLOY $Nb_3Al_{0.75}Ge_{0.25}$. Alekseevski, N. E.; Krasnoperov, E. P. (Inst. of Physics Problems, Moscow). JETP Lett. (USSR) (Engl. Transl Transl.); 16: No. 9, 371-372(5 Nov 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 9, 522-525(5 Nov 1972).

The magnetic susceptibility χ of $Nb_3Al_{0.75}Ge_{0.25}$ was measured at 300 to 19°K. At 300 to 50°K, the variation of χ is T^{-1}, while below 50°K, a flat maximum is observed, followed by a sharp decrease. The temperature dependence of the diamagnetic contribution shows the influence of fluctuations in the superconducting transition. (DLC)

21535 HYSTERESIS OF MAGNETIZATION INTENSITY IN THE VICINITY OF THE MAGNETIC COMPENSATION POINT IN $ErFe_2$ AND $HoFe_3$ ALLOYS. Belov, K. P.; Bisliev, A. M.; Nikitin, S. A.; Kolesnichenko, V. E. (Moscow State Univ.). Fiz. Metal. Metalloved.; 34: No. 3, 470-474(Sep 1972). (In Russian).

The coercive force H_c, residual magnetization σ_r, and temperature hysteresis in the vicinity of the magnetic compensation temperature T_c were investigated in the alloys $ErFe_2$ and $HoFe_3$. A strong increase in H_c during an approach to T_c was observed, which in direct proximity shifted to a sharp decrease. Anomalies in H_c and σ_r in the vicinity of T_c possess the same character as in rare-earth ferrite garnets. The results indicated that in the magnetic field $0 < H < H_c$ at the magnetic compensation temperature of the ferrites investigated, a first-order phase transition occurred. The coexistence of two metastable phases with different magnetic moment orientations of the sublattices was indicated. (tr-auth)

21536 MAGNETIC SUSCEPTIBILITY OF NICKEL BORIDES AT 100 TO 1100°K. Kostetskii, I. L; L'vov, S. N. (Kherson Pedagogical Inst., USSR). Fiz. Metal. Metalloved.; 34: No. 3, 475-478(Sep 1972). (In Russian).

The temperature dependence of the magnetic susceptibility of the borides Ni_3B, Ni_2B, and NiB was investigated at 100 to 1100°K. The results are discussed in the light of 3d-level filling and the influence of various para- and diamagnetic contributions on the total susceptibility. At high temperatures, the susceptibilities of Ni_3B and Ni_2B contain a significant contribution of Pauli paramagnetism. At low temperatures, the presence of localized magnetic moments affects the susceptibility of Ni_3B. NiB is diamagnetic. (tr-auth)

21537 I. MAXIMUM OF THE PARAMAGNETIC SUSCEPTIBILITY AND ITS OCCURRENCE IN URANIUM(IV) COMPOUNDS. Mulak, J. (Inst. for Low Temperature and Structure Research, Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 20: No. 9, 883-889(1972).

It is shown that the magnetic susceptibility of a paramagnetic material with nonmagnetic ground state and magnetic excited state lying within the Boltzmann population range reaches its maximum at some definite temperature. The relations between the position and the magnitude of this maximum and the parameters of Van Vleck's formula are determined. The method is exemplified by calculating the $\chi(T)$ course for the U^{4+} ion in a crystal field of different symmetry. (auth)

21538 II. MAGNETIC PROPERTIES OF UGa_3, UIn_3, and UTl_3. Discussion in Terms of the Paramagnetic Susceptibility Maximum Model. Misiuk, A.; Mulak, J.; Czopnik, A. (Inst. for Low Temperature and Structure Research, Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 20: No. 9, 891-896(1972).

The magnetic properties of UGa_3, UIn_3, and UTl_3 with the $AuCu_3$-type structure were investigated over the range of 4.2 to 900°K. The magnetic susceptibility of UGa_3 is slightly temperature-dependent, whereas those of UTl_3 and UIn_3 indicate the susceptibility maximum at 80 to 90 and 95 to 105°K, respectively. The magnetic properties of the investigated compounds are discussed in terms of the crystal field theory, assuming $^3H_4$ as the ground term of uranium. The temperature dependence of the magnetic susceptibility of UGa_3 indicates the singlet Γ_1 to be the ground level of uranium. The magnetic susceptibility maxima of UIn_3 and UTl_3 can be described in terms of the paramagnetic susceptibility maximum model. The possibility of an antiferromagnetic transition in UIn_3 and UTl_3, however, cannot be excluded. (auth)

21539 CONDUCTION IN LOW-MOBILITY MATERIALS. Proceedings of the Second International Conference Held at Eilat, Israel, April 5–8, 1971. Klein, N.; Tannhauser, D. S.; Pollak, M. (eds.). London; Taylor and Francis Ltd. (1971). 465p. £10. (CONF-710464).

Fifty-two papers were presented in sections entitled: transition metal oxides (including HfO_2, ZrO_2, VO_x), low-mobility transport theory, amorphous semiconductors, selenium compounds, switching processes, organic materials, and ionic crystals and liquids. One paper in the section covering switching processes was in NSA Scope, and a separate abstract was prepared. (UK)

For an abstract of an individual paper see: 20988.

21540 MEASUREMENTS OF USEFUL PARAMETERS WHICH INDICATE THE DIFFUSION PROCESSES IN THE DYNAMIC POLARIZATION. Montelatici, V.; Tomassetti, G. (CNEN, Frascati, Italy). Lett. Nuovo Cim.; 5: No. 3, 285-8(16 Sep 1972).

A differential-equation system is presented whereby dynamic polarization can be studied analytically when the polarization p(t) and P(t) are present for two groups of spins (I) and (S), respectively. Specifically, the protons (I) of the crystallization water and the neodymium ions (S) of the crystal $La_2Mg(NO_3)_{12} \cdot 24H_2O$ + 1% Nd are considered. Some possible properties of the spin diffusion are inferred through measurements of the spin heat bath relaxation time of the protons, of the stationary value of the proton polarization, and of the time constant to build up this value. (auth)

21541 CRYSTAL CHEMISTRY AND PHYSICS OF METALS AND ALLOYS. Pearson, W. B. Wiley Series on the Science and Technology of Materials. New York; John Wiley and Sons, Inc. (1972). 824p.

This book is the first book in English to study the crystal structures of metals in their own right. Emphasis is on description of particular crystal structures, general factors controlling their occurrence, and atomic dimensions in the structures. The 16 chapters cover: introduction; crystal structure relationships; factors; atomic size; valence compounds of metalloids and semiconductors; metastable phases, interstitial phases, and martensitic transformations; structures based on close-packing of 3^6 close-packed nets; structures derived by filling tetrahedral, octahedral, and other holes in close-packed arrays; structure types dominated by triangular prismatic arrangements; simple cubic and bcc packing; square-triangle nets of atoms: cubes and cubic antiprisms; alternate stacking of triangular and Kagomé nets; isosahedra and CN 14, 15, and 16 polyhedra; stacking nets containing squares, pentagons, hexagons, etc.; structures with large coordination polyhedra; and idiosyncratic structures. Subject and formula indexes are included. (DLC)

21542 ELECTRON–NUCLEAR INTERACTIONS IN METAL–HYDROGEN SYSTEMS ON THE BASIS OF THE TRANSITION METALS. Khodosov, E. F.; Shepilov, N. A.; Kurishco, V. I. (Donetsk State Univ., USSR). pp 54-56 of International Congress on Hydrogen in Metals. Vols. 1 and 2. Paris; Editions Science et Industrie (1972).

From International Congress on Hydrogen in Metals Conference; Paris, France (29 May 1972). See CONF-720571-(Vol.1 and 2).

Spin–medium relaxation and Knight shifts occurring in Ti–H, Zr–H, Hf–H, and Nb–H systems were studied as a function of the hydrogen concentration and the temperature in the 77 to 720°K temperature interval. The character of the electron–nucleus interactions (metal–hydrogen) were established for the combinations studied. (France)

21543 DYNAMICAL ASPECTS OF CRITICAL PHENOMENA. Conference Held in New York City, June 9–11, 1970. Budnick, J. I.; Kawatra, M. P. (eds.). New York; Gordon and Breach, Science Publishers, Inc. (1972). 636p. $32.00. (CONF-700674).

The purpose of this conference was to discuss theoretical and experimental studies of critical phenomena in solids in which spin ordering plays an important role. The 32 papers cover dynamical scaling and neutron scattering; light scattering; sound propagation, thermal, and transport properties; phase transitions; magnetism and superconductivity; and cooperative phenomena in biological systems. Separate abstracts were prepared for four of the papers; another paper was previously abstracted as NSA 25: 40538. (DLC)

For abstracts of individual papers see: 20990, and 21545–21547.

21544 HALL AND NERNST–ETTINGSHAUSEN EFFECTS IN SINGLE-CRYSTAL RHENIUM. Kuvandikov, O. K.; Ivanovskii, V. I.; Cheremushkina, A. V.; Vasil'ev, R. P. (Moscow State Univ.). JETP Lett. (USSR) (Engl. Transl.); 16: No. 9, 367-368(5 Nov 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 9, 517-518(5 Nov 1972).

The Hall coefficient R and the Nernst–Ettingshausen coefficient Q were measured for Re single crystals with resistance ratios R(273°K)/R(4.2°K) = 50. The dependence of R and Q on the angle between the magnetic field and the C axis of the crystal is shown. R is strongly anisotropic, with a reversal of sign; this can be attributed to anisotropy of the Fermi surface. (DLC)

21545 NATURE OF THE RESISTANCE ANOMALY OF GADOLINIUM NEAR T_c. Zumsteg, F. C.; Cadieu, F. J.; Marcelja, S.; Parks, R. D. (Univ. of Rochester, NY). pp 292-304 of Dynamical Aspects of Critical Phenomena. Budnick, J. I. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From Conference on Dynamical Aspects of Critical Phenomena; New York; United States of America (USA) (9 Jun 1970). See CONF-700674-.

The electrical resistance of Gd in the c-direction displays a maximum in the vicinity of the ferromagnetic Curie point T_c. According to Fisher and Langer such a maximum, if it is due to spin-disorder scattering, must lie above T_c. Simultaneous measurements of the electrical conductivity, specific heat and magnetic susceptibility of a high-purity Gd single crystal show each of these quantities to have a maximum value within the same 0.2°K temperature interval. By determining the anisotropic correlation function, in the Ornstein–Zernike region, from recent neutron scattering results and using the results of the band structure calculations of Keeton and Loucks, it is shown that the above result can be brought into qualitative agreement with the Fisher–Langer spin scattering model only if very restrictive assumptions are made regarding the Fermi surface topology. However, the present data is consistent with the explanation that the larger part of the resistive anomaly, at least for $T \gtrsim T_c$, has its origin in the observed anomalous behavior of the lattice constant in the c-direction in the vicinity of T_c. (auth)

21546 ROLE OF CRITICAL SCATTERING IN THE ELECTRICAL RESISTIVITIES OF Eu, Tb, AND OTHER RARE-EARTH METALS. Meaden, G. T.; Sze, N. H.; Johnston, J. R. (Dalhousie Univ., Halifax, Nova Scotia). pp 315-325 of Dynamical Aspects of Critical Phenomena. Budnick, J. I. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From Conference on Dynamical Aspects of Critical Phenomena; New York, United States of America (USA) (9 Jun 1970). See CONF-700674-.

It is shown that the critical scattering contribution to the electrical resistivity of bcc Eu and hcp Tb along their c-axes can be described fairly well by mean-field theory to within a few degrees of their upper magnetic critical temperatures. However, a much more detailed analysis, based on a high density of experimental points, reveals a logarithmic term only between $T_N + 8$ and $T_N + 35$°K for Eu and between $T_N + 0.6$ and $T_N + 3$°K for Tb. Tb displays a new effect with $d\rho/dT \propto (T-T_N)^{-\frac{1}{2}}$ for $3 < T-T_N < 12$. The specific heat of Tb has a similar temperature dependence. (DLC)

21547 ELECTRICAL RESISTIVITIES DUE TO SHORT-RANGE CORRELATIONS IN THE RARE EARTH METALS. Geldart, D. J. W.; Richard, T. G. (Dalhousie Univ., Halifax, Nova Scotia). pp 326-332 of Dynamical Aspects of Critical Phenomena. Budnick, J. I. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From Conference on Dynamical Aspects of Critical Phenomena; New York, United States of America (USA) (9 Jun 1970). See CONF-700674-.

Transport phenomena in the rare earth metals are rather directly dependent on the Fermi surface geometry. The effects of this anisotropy on the electrical resistivity are discussed for the heavy hcp rare earths which have Fermi surfaces exhibiting webbing or nesting features. Results are shown to provide a reasonable account of the temperature variation of the electrical resistivity of Tb in its paramagnetic state. The case of bcc Eu, which is much more isotropic than the hcp rare earths, is also discussed. (Metals Abstr.)

21548 PHASE SHIFT INVERSION OF FERMI SURFACE DATA FOR SOME OF THE TRANSITION METALS. Shaw, J. C.; Ketterson, J. B.; Windmiller, L. R. (Argonne National Lab., IL). Int. J. Quant. Chem., Symp.; No. 6, 395-402(1972).

From International Symposium on Atomic, Molecular and Solid-State Theory and Quantum Biology; Sanibel Island, Florida, United States of America (USA) (17 Jan 1972).

See CONF-720127-.

Preliminary results are presented for the conversion of de Haas–van Alphen data into information concerning the point properties of the Fermi surfaces of the transition metals. It is shown that the spin-orbit generalized phase shifts may be used to fit the Fermi surfaces of the heavy transition metals. (auth)

21549 THEORY OF THE CRYSTAL STRUCTURES OF TRANSITION METALS AT ABSOLUTE ZERO. Pettifor, D. G. (Imperial Coll. of Science and Tech., London). pp 191-199 of Metallurgical Chemistry. Kubaschewski, O. (ed.). London; Her Majesty's Stationery Office (1972).

From International symposium on metallurgical chemistry; London, UK (14 Jul 1971). See CONF 710738–.

An attempt is made to find a quantitative explanation for the changes in the structure of the transition metals from Sc to Au. The concept of the d-electrons resonating in the crystal potential is used, and the width W of the d-band level E_d are used as the resonant parameters. An equation is derived for the differences in energy between the crystal structures, and values are derived for the various terms (d-electron resonant level, band structure energy). The term which primarily determines the favored structure at absolute zero involves the band structure contribution to the total energy. (DLC)

21550 REACTIVITY OF SOLIDS. Proceedings of the Seventh International Symposium, Bristol, England, July 17–21, 1972. Anderson, J. S.; Roberts, M. W.; Stone, F. S. (eds.). London; Chapman and Hall Ltd. (1972). 824p. 11 pounds. (CONF-720703).

Sixty-nine papers were presented in sections entitled: defect chemistry, the vitreous state, diffusion processes and diffusion-controlled reactions, amorphous materials and phase transformations, dislocations and nucleation, reactions of the organic solid state, solid-state reaction mechanisms in an applied context, surface structure and processes, and reaction processes — structural and mechanistic. Separate abstracts were prepared for seven papers. (UK)

For abstracts of individual papers see: 19563, 19641, 20264, 20281, 21514, 21515, and 21558.

21551 LOW-ENERGY ELECTRON SPECTROSCOPY IN GRAPHITE. Verdier, A. (Office National d'Etudes et de Recherches Aerospatiales, Chatillon, France). Compt. Rend., Ser. B; 275: No. 20, 739-742(13 Nov 1972). (In French)

Characteristic energy losses due to plasma oscillation excitation of the electrons in graphite were studied. (France)

21552 THERMOELECTRIC POWER OF CERIUM, LANTHANUM, NICKEL, AND COBALT IN THE VICINITY OF THE MELTING POINT. Howe, R. A.; Enderby, J. E. (Univ. of Leicester, Eng.). J. Phys., F (London); 3: No. 1, L12-L14 (Jan 1973).

The thermoelectric powers of cerium, lanthanum, nickel, and cobalt were measured at temperatures just above and just below the melting point. The results, which seem to conform to a general pattern of behavior, are compared with the other electronic transport parameters. (auth)

21553 OBSERVATION OF MAGNETIC DOMAIN PATTERNS IN TERBIUM AND DYSPROSIUM. Herring, C. P.; Jakubovics, J. P. (Oxford Univ.). J. Phys., F (London); 3: No. 1, 157-160 (Jan 1973).

Magnetic domain patterns on terbium and dysprosium single crystals at liquid helium temperature were obtained by the method of Hutchinson et al. (J.sci.Instrum.; 42:885-6 (1965)). On (0001) surfaces, the patterns consisted of markings parallel to $\langle 1\bar{1}00 \rangle$ directions. On surfaces parallel to [0001], the patterns consisted of lines and bands both parallel and perpendicular to [0001]. The main features of the patterns on terbium could be interpreted on the basis of a structure consisting of thin slab-like domains, magnetized in $\langle 1\bar{1}00 \rangle$ directions, separated by 180° domain walls lying on (0001) planes, together with surface closure domains. The patterns on dysprosium have similar features to those on terbium but they are difficult to interpret on the assumption that the easy directions of magnetization are $\langle 11\bar{2}0 \rangle$. (auth)

21554 EFFECT OF d ELECTRONS ON CRYSTAL-FIELD POTENTIALS IN RARE EARTH METALS AND DILUTE ALLOYS. Dixon, J. M.; Dupree, R. (Warwick Univ., Coventry, Eng.). J. Phys., F (London); 3: No. 1, 118-124(Jan 1973).

The effect of 5d character on the crystalline electric field (CEF) in noble metal–rare earth alloys and in pure rare earths was investigated. The change in sign of the fourth-order CEF coefficient in the noble metal alloys can be interpreted in terms of this d character. From symmetry this d-like component has no effect on the sixth-order coefficients whose varying magnitude in these

alloys can be explained using the f-like contribution. In the pure rare earth metals it is likely that d character will predominate. (auth)

21555 SIMPLE THEORY OF THE ELECTRON–PHONON MASS ENHANCEMENT IN TRANSITION METALS. Evans, R.; Gaspari, G. D.; Gyorffy, B. L. (Bristol Univ., Eng.). J. Phys., F (London); 3: No. 1, 39-54(Jan 1973).

Using information available from band structure calculations, neutron scattering experiments, and a simple theory of the electron–phonon coupling, the mass enhancement factor λ was calculated for ten transition metals: Zr, Nb, Mo, Ta, W, Re, Rh, Pd, Ir, and Pt. For the superconducting elements, the results are in good qualitative and in reasonable quantitative agreement with the empirical values of λ obtained from data on the superconducting transition temperature. The magnitude of λ in the nonsuperconducting metals is discussed. (auth)

21556 THERMAL ACTIVATION PARAMETERS FOR LOW-TEMPERATURE DEFORMATION OF ALPHA-HAFNIUM. Little, E. A.; Sastry, D. H.; Vasu, K. I. (Indian Inst. of Science, Bangalore). Scr. Met.; 7: No. 2, 131-135(Feb 1973).

Measurements of the activation volume and activation energy for Hf at temperatures below 1000°K were performed using differential-stress creep experiments and temperature and strain-rate dependences of flow stress. The thermal activation energy was plotted vs effective shear stress; extrapolation to zero stress gave $H_0 = 0.85$ eV. The activation volume decreases with stress, reaching a limiting value of $\sim 15b^3$ (b = Burgers vector of dislocation). (DLC)

21557 STUDY OF THE NIOBIUM–OXYGEN SOLID SOLUTION UTILIZING SOLID ELECTROLYTIC CELLS. Nickerson, W.; Alstetter, C. (Univ. of Illinois, Urbana). Scr. Met.; 7: No. 2, 229-232(Feb 1973).

Equilibrium emf measurements were made at 850 to 1300°C. Straight-line fits were made on the emf vs temperature plots, giving a standard enthalpy of +8000 ± 300 cal/mole and entropy change of +7.8 ± 0.4 cal/mole-°K for the dissolution of oxygen. The solvus line was also plotted. The standard heat of solution and entropy of solution are calculated to be −91,370 cal/mole and −13.3 cal/mole-°K, respectively. An absolute entropy of +16.6 cal/mole-°K is calculated for the oxygen atom in solution in Nb. (DLC)

21558 ELECTRON SPIN RESONANCE STUDY OF URANIUM DIOXIDE. Tench, A. J.; Kibblewhite, J. F. J.; Wheeler, V. J. (Atomic Energy Research Establishment, Harwell, Eng.). pp 38-45 of Reactivity of Solids. Anderson, J. S. (ed.). London; Chapman and Hall Ltd. (1972).

From 7th International Symposium on the Reactivity of Solids; Bristol, United Kingdom of Great Britain and Northern Ireland (UK) (17 Jul 1972). See CONF-720703–.

Samples of UO_2 prepared by sintering in hydrogen at 1950°K sometimes show a strong ESR signal, which is not easily saturated at higher microwave power and which exhibits an unusual temperature dependence. The origin of this signal is explored by examining a range of samples of different stoichiometries prepared by controlled reduction/oxidation techniques. The signal is interpreted as due either to U^{4+} ions or U^{3+} ions in an unusual environment arising from the oxidation of small U metal particles formed from the disproportionation of UO_{2-x}. (auth)

21559 TRANSITION OF AMORPHOUS LAYERS OF Bi AND Yb TO THE CRYSTALLINE STATE UNDER THE INFLUENCE OF A MAGNETIC FIELD. Kuz'menko, V. M.; Lazarev, B. G.; Mel'nikov, V. I.; Sudovtsov, A. I. (Physical–Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 11, 1923-1924 (Nov 1972). (In Russian).

Vapors of Bi and Yb (at liquid He temperature) condensed onto a glass support formed amorphous films. These films underwent an irreversible transition to the crystalline state upon the application of a magnetic field perpendicular to the plane of the film; the required intensity of the magnetic field to induce this phenomenon was a function of the thickness of the amorphous layer. (KSW)

21560 PHYSICAL PROPERTIES OF Nd–Sb ALLOYS AND THEIR CORRELATION WITH THE PHASE DIAGRAM. Kungurov, I. M.; L'vov, S. N.; Chernogorenko, V. B.; Kobzenko, G. F. (Kherson Pedagogical Inst., USSR). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 11, 1787-1790(Nov 1972). (In Russian).

Concentrational dependences of electric resistivity ρ, magnetic susceptibility χ, thermal conductivity coefficients λ, thermoelectromotive force, Hall coefficient R as well as temperature dependences of ρ, λ, α of the system Nd–Sb alloys were studied at 100 to 900°K. Correlation of the property–composition curves with the phase diagram supports the conclusion drawn earlier on the existence of the compounds Nd_5Sb_3, Nd_4Sb_3, NdSb, and $NdSb_2$ in the system. The data enable a conclusion to be made on the metallic character of conductivity in the compounds. All the compounds are paramagnetic. The concentration dependence of the magnetic susceptibility permits one to state that interatomic interactions in the compounds do not affect the 4f-shell. (auth)

21561 MAGNETIC DOMAINS IN $Co_{17}R_2$, $(Co,Fe)_{17}R_2$ AND Co_7R_2 COMPOUNDS. Livingston, J. D. (General Electric Co., Schenectady, NY). J. Mater. Sci.; 7: No. 12, 1472-1476(Dec 1972).

A study was made of magnetic symmetries in several $Co_{17}R_2$, $(Co,Fe)_{17}R_2$ and Co_7R_2 phases by means of magnetic domain observations. Compounds were arc-cast from high-purity materials and studied metallographically either in the as-cast condition or after annealing. Domains were observed in polarized light on a Bausch and Lomb metallograph, using an elliptical compensator to optimize contrast. Examples are shown of the rosette structure characteristic of easy-axis magnetic symmetry. Easy-axis domain patterns were seen in $Co_{17}Sm_2$, $Co_{17}Gd_2$, and several $(Co,Fe)_{17}R_2$ and Co_7R_2 compounds. Domains were not seen in $Co_{17}Pr_2$, $Co_{17}Y_2$, $CO_{17}Nd_2$, or $Co_{17}Ce_2$. (UK)

Moessbauer Effects and NMR

Refer also to abstract 19966.

21562 MOESSBAUER OLAYI. (Moessbauer effect). Unak. T. Izotop Arastirma Merkezi Yayinlari, No. 3. Bornova, Turkey; Ege Universitesi Matbaasi (1972). 83p. (In Turkish).

The basic principles of the Moessbauer effect are examined, and its potential applications are considered. The various chapters deal with recoil, energy levels in atoms, including electron and nuclear levels, vibrational energy in crystal, the Doppler effect, optical resonance, nuclear resonance and the concept of resonance cross sections. After the basic introduction, Moessbauer's discovery is outlined, describing the various experimental techniques used to observe the effect and to obtain Moessbauer spectra. The section on theoretical considerations includes a discussion of the Debye–Waller factor and its temperature dependence. This is followed by a chapter on potential applications of the Moessbauer effect, such as the isomeric shift, the quadrupole splitting, chemical applications with ^{57}Fe and ^{119}Sn and a review of other physical and biological applications. (72 references) (TTT)

PHYSICS (THEORETICAL)

Refer also to abstracts 20833, 20951, 21120, and 21189.

21563 (COO-3077-10) PROGRESS REPORT No. 48, JULY 1, 1971-JUNE 30, 1972. (New York Univ., N. Y. AEC Computing and Applied Mathematics Center). 1 Nov 1972. Contract AT-(11-1)-3077. 29p. Dep. NTIS.

Research on applied mathematics and mechanics, theoretical physics, computer science, and computer operations and programing is summarized. A list of publications is included. (JFP)

21564 (DESY-72/64) SUBJECT, OBJECT, AND MEASUREMENT. Haag, R. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Nov 1972. 8p. (CONF-720982-1). Dep. NTIS (U. S. Sales Only).

From International symposium on the physicist's conception of nature; Trieste, Italy (18 Sep 1972).

Quantum physics theory is discussed which is required to classify possible types of systems and events, provide information about the set through which ϵ may range for each type of system, and determine the probabilities for each type of event. The examples discussed are the passage of cosmic radiation through the atmosphere and the decay of a spin-zero particle into two charged spin-$\frac{1}{2}$ particles. (JFP)

21565 (INP-809) GENERALIZED OSCILLATOR IN THE FRAMEWORK OF MATRIX MECHANICS. Kapuscik, E. (Institute of Nuclear Physics, Krakow (Poland)). Sep 1972. 10p. Dep. NTIS (U. S. Sales Only).

Generalizing the kinematical relation between the momentum and velocity, new solutions of the oscillator dynamics are described. (auth)

21566 RELATIVISTIC EQUATIONS OF MOTION OF CHARGED MAGNETIC ROTATING BODIES. Ryabushko, A. P. (Belorussian Inst. of Mechanization of Agriculture, Minsk). Vestsi Akad. Navuk BSSR, Ser. Fiz.-Mat. Navuk; No. 1, 86-98(1972). (In Russian).

Post-Newtonian equations of translational and rotational motion were obtained for systems of bodies possessing a magnetic charge, changing magnetic field of a dipole type, and an intrinsic rotation, using a refined approximation method of Einstein-Infeld. The influence of electromagnetic radiation on the motion of the bodies is described. A comparison is made with known results. (tr-auth)

21567 QUASICLASSICAL EXPANSION AND EXPONENTIAL METHOD. Kolkunov, V. A.; Mel'nikov, V. N. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 16: No. 5, 1125-1134(1972). (In Russian).

On the basis of the exponential method there has been investigated a quasiclassical expansion of the wave function in powers of $\hbar$. It is shown, that quasiclassical expansion is an asymptotic one, which does not take into account wave interaction. The asymptotic features of quasiclassics is the cause the reflection coefficient turns to zero at above barrier penetration in any order in $\hbar$. Account for the terms of the first order in $\hbar$, leads as a rule to wrong results. (auth)

21568 NEW METHOD OF QUANTIZATION AND SOME OF ITS APPLICATIONS. Kademova, K. V. (International Centre for Theoretical Physics, Trieste, Italy); Kraev, M. M. Int. J. Theor. Phys.; 6: No. 6, 443-452(Dec 1972).

Any quantum-mechanical problem with 0(2,1) as SGA (spectrum-generating algebra) is considered as a single oscillator related to a new quantization. In the case of small interactions the problems can be solved within essentially Fock representations while in the case of strong attractive potentials they can be solved only within the essentially non-Fock representations of the new commutation relations. Explicit realizations of a system of n oscillators through para-Bose operators have been constructed. (auth)

21569 PLANE FRAME FUNCTIONS AND PURE STATES IN HILBERT SPACE. Gudder, S. (Univ. of Denver). Int. J. Theor. Phys.; 6: No. 5, 369-375(Dec 1972).

An elementary proof of Gleason's theorem (J. Maths. Mech.; 6: 885(1957)) for pure states in a Hilbert space is given. This theorem follows from a general result concerning plane frame functions in real inner product spaces. (auth)

21570 EQUIVALENT FORMS OF THE COMPLEX CLASSICAL EQUATIONS OF QUANTUM MECHANICS. Kaliski, S. (Inst. of Fundamental Technological Research, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 20: No. 7-8, 617-623(1972).

The subject matter of the present considerations is the passage from the equations of the "classical" approach to quantum mechanics in v complex to equations in real v, showing that the assumption of interaction between the particle and vacuum and the deterministic interpretation remain the same with the new set of equations. Some problems of equivalence of the classical approach to quantum mechanics based on the model of vacuum with a chain of creation and annihilation and the model of a particle in a stochastic field in vacuum are also discussed. (auth)

REACTOR TECHNOLOGY

Power Reactor Development

Refer also to abstract 21858.

21571 (BLG-467) ANNUAL SCIENTIFIC REPORT, 1971. Billiau, R.; Bobin, K.; De Coster, M.; Fredrix, H.; Hespeels, L. (eds.) (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). 317p. Dep. NTIS (U. S. Sales Only).

Included are 9 chapters which summarize the various activities of the research center during 1971. A separate abstract was prepared for each chapter. (HDR)

For abstracts of individual chapters see: 19422, 19737, 19738, 19810, 21490, 21572, 21617, 21859, and 21860.

21572 (BLG-467, pp 2.1-36) DEVELOPMENT OF THERMAL REACTORS.

BELGIAN REACTOR-3—operation with plutonium recycle fuel pins, summary of 1971
PLUTONIUM—recycle in thermal reactors, development of fuels for
PLUTONIUM OXIDES PuO_2—PuO_2–UO_2, development of thermal reactor recycle fuels of
REACTOR FUEL ELEMENTS—radiation testing of mixed oxide, for plutonium recycle in thermal reactors
REACTOR FUELS—development of coated particle HTGR-type
—development of mixed oxide, for plutonium recycle in thermal reactors
REACTORS, GAS COOLED—fuels for high temperature, development of coated particle
REACTORS, PRESSURIZED WATER—fuels for, development of plutonium recycle
REACTORS, THERMAL—fuels for, development of plutonium recycle
URANIUM OXIDES UO_2—development of reactor fuels of (HDR)

21573 (EURFNR-1038) FAST BREEDER PROJECT. Second Quarterly Report, 1972. (Kernforschungszentrum, Karlsruhe (West Germany)). Sep 1972. 251p. (KFK-1272/2). Dep. NTIS (U. S. Sales Only).

Work performed under United States–Euratom Fast Reactor Exchange Program.

REACTOR FUEL ELEMENTS—development of pin-type fast breeder
—radiation testing of pin-type fast breeder
—cladding for fast breeder, development and testing of stainless steel
REACTORS, BREEDER—fuel elements for, development and radiation testing of pin-type
—fuel, element cladding for, development and testing of stainless steel
—cooling systems for, materials corrosion in, (E)
—physics parameters for, (E/T)
REACTORS, FAST—fuel elements for, development and radiation testing of pin-type
—fuel element cladding for, development and testing of stainless steel
—cooling systems for, materials corrosion in, (E)
—physics parameters for, (E/T)
—power excursions in, model for, (T)
—components for, safety aspects in performance of, (E)
—cooling system for sodium cooled, analysis of perturbations in
—core instrumentation for sodium cooled
—components for sodium cooled, effects of sodium on, (T)
—development of gas cooled, research on
—development of sodium cooled, design studies on
REACTORS, GAS COOLED—development of fast breeder, research on
REACTORS, LIQUID METAL COOLED—components for sodium cooled, effects of sodium on, (T)
—development of sodium cooled, design studies on
— cooling system for sodium cooled, analysis of perturbations in
—core instrumentation for sodium cooled
SNR REACTOR—accident in, aerosol concentration in outer containment structure following, (T) (JWR)

21574 (EURFNR-1056) FAST REACTOR PROGRAMME. THIRD QUARTER 1972 PROGRESS REPORT. Hoekstra, E. K. (comp.) (Reactor Centrum Nederland, Petten). Nov 1972. 82p. (RCN-180). Dep. NTIS (U. S. Sales Only).

Work performed under United States–Euratom Fast Reactor Exchange Program.

AEROSOLS—formation in sodium cooled fast reactor accidents, simulation of
CRITICAL ASSEMBLIES—physics experiments in STEK
FISSION PRODUCTS—effects on physics parameters of fast sodium cooled reactor cores
REACTOR FUEL ELEMENTS—performance testing of sodium cooled, during overload conditions
—heat transfer from rod-type, in sodium and air, (E)
REACTOR FUELS—radiation testing of uranium carbonitride
REACTORS, FAST—development of sodium cooled, during July through September 1972
—safety of sodium cooled, research program on
—physics parameters of sodium cooled, effects of fission products on
—fuel elements for sodium cooled, development and testing of
—core heat transfer in sodium cooled, rod-bundle mockup measurements of
REACTORS, LIQUID METAL COOLED—development of sodium cooled, during July through September 1972
—safety of sodium cooled, research program on
—physics parameters of sodium cooled, effects of fission products on
—fuel elements for sodium cooled, development and testing of
—core heat transfer in sodium cooled, rod-bundle mockup measurements of
URANIUM CARBONITRIDES—use as reactor fuel, irradiation and thermal testing for (JWR)

21575 FAST NEUTRON REACTORS. PART II. Debrue, J. (CEN-SCK, Mol, Belg.). Rev. Quest. Sci.; 143: No. 1, 87-107 (Jan 1972). (In French).

The characteristics of power reactors are discussed in detail. The experience acquired in research and development programs on fast neutron reactors is then summarized. Possible future development is considered. (JSR)

21576 ONE-WAY SPHERICAL PILE REACTOR FOR ELECTRICITY PRODUCTION. Maly, V.; Teuchert, E. (Kernforschungsanlage, Juelich, Ger.). Atomwirt., Atomtech.; 17: No. 9-10, 518-19(1972). (In German).

The one-way loading principle of the pebble bed reactor, which was studied and developed for process heat generation, also offers considerable technological advantages with respect to electricity production. It is superior to the conventional HTR. The OTTO mode of operation prevents superheating of the fuel material. Under these conditions, the spheres suffer only a small degree of temperature stress which lies considerably below permissible limits. This is especially true for 2-circuit installations; however, in one-circuit installations, the once-through reactor can be operated below conventional stress limits. (tr-auth)

21577 COMPARATIVE EVALUATION OF METHODS OF THERMAL CALCULATION FOR WATER COOLING TOWERS. Berman, L. D.; Zauer, A. Therm. Eng. (USSR) (Engl. Transl.); 18: No. 8, 59-63(Aug 1971).

Thermal efficiency calculations for water cooling towers for fossil or nuclear power plants require the solution of a system of differential equations of heat and mass transfer and of the draught equation. The various methods for solving these equations are compared. (JWR)

21578 IMPROVING POWER SYSTEM RELIABILITY THROUGH STANDARDIZATION WITH SPECIFIC REFERENCE TO NUCLEAR POWER REACTORS. Fleischmann, W. L. (General Electric Co., Schenectady, N. Y.); Ringlee, R. J. Nucl. Eng. Des.; 19: No. 2, 237-57(1972).

From first international conference on structural mechanics in reactor technology; Berlin, Germany (20 Sep 1971). See CONF-710903-(Vol.19,No.2).

Important industrial as well as power generating equipment usually shows a gradual growth in the early stages of development. Yet, over the past 20 years, the size of the largest fossil-fuel-fired plant installed each year increased at a compounded rate of 13.3 percent per annum. Nuclear power plants (pressurized water and boiling water) have increased in size at an even larger rate. The technology of these large in conventional terms but small in comparison to the size of the generation of equipment to be installed next is based on demonstration plants. These demonstration plants take the place of prototype plants. Basic engineering data for the commercial nuclear power plants are derived from the design, manufacture, installation, and operation

of these demonstration plants. The continuing increase in unit size from 90 MW(e) in 1957 to 1000 MW(e) to be installed in 1971 has required concurrent development with production to be sure that plants of progressively increasing size supply power reliably. Results of such developments have to be checked continuously against actual performance data obtained in the operation of plants. The basis from which the scale-up starts has to be well established so that changes required for design, manufacture installation, and operation can be evaluated in relation to past practices and operating experiences. Past practices are codified in standards that become the criteria for evaluating proposed changes. Development of standards in which review activities play a dominant role is a major part in the engineering plan for a nuclear plant. The management practice to be applied to ensure reliable performance from power generating plants designed during rapidly evolving states of development in power plant technology is discussed. The management practices will cover the gamut from those established for data collection of outages of power plant equipment to those needed to ensure that experiences from operating plants and tests are fed into the new designs of increased size. Appropriate examples from the field of materials engineering that support that value of cited practices are described. (auth)

Physics and Core Engineering

Refer also to abstracts 21152 and 21922.

21579 (BMBW-FBK-72-20) ADDITIONAL PROGRAM BWR-CONTROL (XENON-PROGRAM). Schmidt, U. (Allgemeine Elektricitaets-Gesellschaft, AEG-Telefunken, Frankfurt am Main (West Germany)). Dec 1972. 78p. (In German). Dep. NTIS (U. S. Sales Only).

The BWR-control Xenon program is intended to control the Xenon-concentration-distribution in the reactor core of boiling water reactors. The axial Xenon-model AXEMO was developed in collaboration with EURATOM, CCR Ispra. This computer program resolves the dependence on time for the axial neutron diffusion problem for presupposed transients. The feedback according to the Xe-poisoning and the thermo-hydraulic change of condition is considered. Numerous experiments were performed in the boiling water reactors Gundremmingen and Lingen for examining the influence of Xenon for the power distribution. A parameter study was performed for different transients. (auth)

21580 (CEA-CONF-2103) PHYSICS OF HIGH TEMPERATURE REACTORS AT THE COMMISSARIAT A L'ENERGIE ATOMIQUE. Laponche, B. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires); Morier, F. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). 1972. 21p. (CONF-720901-14). Dep. NTIS (U. S. Sales Only).

From Meeting on new developments in reactor physics and shielding calculations; Kiamesha Lake, NY (12 Sep 1972).

The current experimental programme on High Temperature Reactor Physics achieved at the Commissariat à l'Energie Atomique is presented. The main studies are based on the low enriched uranium cycle and the tubular interacting fuel element. A first phase, already completed, deals with buckling, k_∞ and reaction rate measurements in MARIUS at room temperature: buckling was measured by flux mapping and progressive replacement on a 3.5% enriched UO_2 particulate fuel lattice; k_∞ was measured by the null reactivity method (PCTR technique) on a 1% enriched UO_2 particulate fuel lattice; spectrum indices and relative conversion ratio were also measured in both lattices. Data analysis has been performed using the APOLLO code as part of a general comparison between calculation and experiment covering a variety of uranium fuel types and the three main moderators. The conclusions of this study are also given. A second phase of experimentation (1973) deals with temperature coefficient measurement in CESAR (from 20 to 450°C) on the same lattice and oscillation measurement of UO_2-PuO_2 particulate samples. A third phase, part of a tripartite programme (UKAEA–DRAGON Project–CEA) is based on irradiated fuel studies: chemical and isotopic analysis of fuels irradiated in the DRAGON Reactor and oscillation of irradiated samples. In cooperation with KFA Jülich, a critical experiment also took place in CESAR in 1972. Fluxes, reaction rates and control rod worth were measured at room temperature in a central zone of the reactor, loaded with balls (3.5% enriched UO_2 particulate fuel). 16 references. (auth)

21581 (JAPFNR-78) EFFECT OF UNCERTAINTY IN NUCLEAR CONSTANTS ON NUCLEAR CHARACTERISTICS SENSITIVITY ANALYSIS OF NUCLEAR CONSTANTS FOR THE CORE OF MONJU REACTOR. Yamamoto, M.; Maki, K.; Zukeran, A. (Hitachi, Ltd., Tokyo (Japan)). May 1972. 83p. (PNC-SJ-202-72-5). Dep. NTIS (U. S. Sales Only).

For Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan.

A sensitivity analysis of nuclear constants for MONJU nuclear characteristics was performed. The sensitivity coefficients for each nuclear constant were calculated. From these results, the degree of the necessity for further evaluation of each nuclear constant is discussed. (auth)

21582 (JAPFNR-82) STUDY OF HETEROGENEITY EFFECTS ON THE SODIUM VOID COEFFICIENTS. III. (Mitsubishi Atomic Power Industries, Inc., Omiya (Japan)). Jun 1972. 17p. (PNC-J-72-17). Dep. NTIS (U. S. Sales Only).

For Power Reactor and Nuclear Fuel Development Corp., Tokai, Japan.

The heterogeneity effect of the cladding and sodium on the axial neutron leakage component of the sodium void coefficient was investigated. The axial diffusion coefficient was calculated with Benoist's method by taking account of the heterogeneity and compared with those previously obtained by a clad-sodium homogenization. The negative leakage component of the sodium void coefficient was found to be underestimated by about 40% in the case where the cladding and sodium were homogenized. (auth)

21583 IMPROVED REACTIVITY TABLE MODEL FOR LIQUID METAL FAST BREEDER REACTOR DYNAMICS. Stacey, Weston M. Jr. (Argonne National Lab., Ill.). Nucl. Sci. Eng.; 49: No. 2, 213-27(Oct 1972).

Variational expressions are presented for the estimation of the parameters of the adiabatic neutron kinetics model. The accuracy and limit of applicability of these variational estimates is established for liquid metal fast breeder reactor (LMFBR) applications by an extensive numerical study. An extended reactivity-table model, in which the mutual interaction of the different perturbations is treated on the basis of the variational estimates, is developed which is comparable in accuracy to the adiabatic model for a wide range of LMFBR transients. (auth)

21584 NEW CONTINUOUS SLOWING-DOWN THEORY FOR FAST REACTOR SPECTRA. Yamamoto, Hisashi; Ito, S. I. (Hitachi Atomic Energy Research Lab., Kawasaki, Japan). J. Nucl. Sci. Technol. (Tokyo); 9: No. 11, 662-9(Nov 1972).

A new analytic representation for fast neutron spectra is described, based on the continuous slowing-down theory using generalized slowing-down parameters $\xi(u)$, $\gamma(u)$ in order to take account of inelastic scattering. The theory is basically formulated for neutrons moderated from monoenergetic source. For fast reactor spectra calculations, the fission source is generated by means of fictitious inelastic scattering. Examples of calculation show good agreement with multigroup calculations. 11 references. (auth)

21585 SOME PHYSICS CALCULATIONS FOR THE GAS COOLED FAST BREEDER REACTOR. 1. CALCULATIONAL METHODS AND PHYSICS DESIGN OF A PIN-TYPE GAS BREEDER REACTOR. Huebner, A.; Dreisvogt, H. (Hochtemperatur Reaktorbau GmbH, Mannheim, Ger.). Atomkernenergie; 20: No. 1, 55-64(Sep 1972). (In German).

The physics design work done for a gas cooled fast breeder reactor using stainless steel clad fuel pins is described. After a short description of the nuclear data libraries and the calculational methods, the performance results are discussed. It is shown, that this type of gas breeder reactor offers an excellent breeding ratio, a low doubling time and the potential to achieve long refuelling intervals. 25 references. (auth)

21586 INFLUENCE OF FISSION NEUTRON SPECTRA ON INTEGRAL NUCLEAR QUANTITIES OF FAST REACTORS. Kiefhaber, E.; Thiem, D. (Kernforschungszentrum, Karlsruhe, Ger.). pp 129-148 of Prompt fission neutron spectra. Vienna; International Atomic Energy Agency (1972).

From Proceedings of a Consultants' Meeting on Prompt Fission Neutron Spectra; Vienna, Austria (25 Aug 1971). See STI-PUB-329; CONF-710845-.

A few preliminary results on the influence of fission neutron spectra on important integral quantities of fast critical assemblies have been reported previously. The scope of those studies was limited for two reasons: only a small number of integral quantities for a few assemblies have been studied, and the various forms used previously for the energy dependence of the fission spectrum were of limited accuracy. In the present work the forms of the fission spectra are taken from the KEDAK and ENDF/B libraries. The various forms are compared with each other and with the standard fission spectrum generally used in calculations, which belongs to $\nu = 2.8$ of the Russian ABN set of group constants. The influence of the different forms on calculated integral quantities

for fast critical assemblies and on important characteristics of large fast power reactors is investigated. Some implications for the programs used to calculate flux distributions are outlined. Important conclusions of the present study are summarized. (5 figures, 4 tables) (auth)

21587 REACTOR WITH AN ECCENTRICALLY DESIGNED CORE. Martsymova, L. A.; Torlin, B. Z. At. Energ. (USSR); 33: No. 6, 992-994(Dec 1972). (In Russian).

The core of a remodelled reactor was arranged eccentrically relative to the heavy water reservoir. The distribution of the thermal neutron flux in the reflector with this rearrangement was computed. (KSW)

21588 CORRELATION BETWEEN THE INTEGRAL DATA OBTAINED IN PARTIAL AND FULL MOCK-UP SYSTEMS. Kuroi, Hideo; Koyama, Kinji; Mitani, Hiroshi (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 9: No. 11, 685-8(Nov 1972).

A generalized perturbation method for studying the relation between results from partial and full mock-up experiments is discussed. (JWR)

21589 REACTOR PHYSICS: CONCLUSION. Bussac, J. (CEN de Saclay, Gif-sur-Yvette, France); Clouet d'Orval, C. Bull. Inform. Sci. Tech. (Paris); No. 170, 95-100(May 1972). (In French).

An attempt is made to demonstrate the value of neutron studies in the research and development of all types of power reactor, particular emphasis being placed on critical experiments. (France)

21590 DETERMINATION OF REACTIVITY COEFFICIENTS IN FAST REACTORS. Heindler, Manfred (Technische Hochschule, Graz). Acta Phys. Austr.; 33: No. 3-4, 349-64(1971). (In German).

Based on the static definition of reactivity, approximation methods are proposed for the numerical determination of reactivity coefficients. The methods pertain to the self-shielding samples with finite size. Calculations are compared with experimental findings on structural materials and on boron. (tr-auth)

21591 CROSS SECTION ENERGY FINE STRUCTURE OF ^{239}Pu IN UNRESOLVED RESONANCE REGION. Takeda, S.; Yamamoto, M. (Hitachi Ltd., Kawasaki, Japan). J. Nucl. Sci. Technol. (Tokyo); 9: No. 10, 624-6(Oct 1972).

21592 SIMPLE COMPUTATIONAL MODEL FOR ROD MOTION TRANSIENTS. Diamond, D. J.; Lellouche, G. S.; Levine, M. M. (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng.; 49: No. 2, 239-43(Oct 1972).

A simple model is described for calculating transients initiated by control rod motion. Certain parameters which can be obtained from one accurate space–time calculation of such a transient can be adjusted in a transparent way to allow other transients with altered control and SCRAM rod parameters to be computed with a point reactor model. (auth)

21593 BENEFITS OF REACTOR PHYSICS EXPERIMENTS FOR THE HTGR INDUSTRIAL DEVELOPMENT: AN ATTEMPT TO A QUANTITATIVE APPROACH. Cuniberti, R. (CCR-EURATOM, Ispra, Italy); Graziani, G.; Massimo, L.; Rinaldini, C.; Zanantoni, C. Energ. Nucl. (Milan); 19: No. 10, 593-606(Oct 1972).

The available results of reactor physics experiments on HTGRs and their accuracies are briefly reviewed. The physical quantities of interest are grouped into three categories: basic nuclear data, lattice parameters and integral design data. The last two are considered and their possible improvements in accuracy by means of experimental measurements are assessed. The cost penalty on fuel cycle and capital cost due to each physical quantity is then considered, and consequently the benefits of reactor physics experiments are evaluated for a number of hypotheses concerning the foreseeable HTGR development and the delay in taking practical advantage of experimental results. It is concluded that, at the present state of knowledge of basic nuclear data and with the available calculation methods, the economic incentive to new reactor physics experiments is small, and a previous careful analysis is recommended to those intending to perform such experiments. (16 references) (auth)

Control Elements, Systems, and Instrumentation

21594 (AD-747500) APPLICATION OF DIGITAL TECHNIQUES TO A NUCLEAR REACTOR SAFETY MONITOR FOR THE LIQUID METAL FAST BREEDER REACTOR. Elrod, S. A. (Naval Postgraduate School, Monterey, Calif.). Mar 1972. 70p. NTIS.

Thesis.

A nuclear reactor safety monitor incorporating hard-wired, redundant, digital program modules that control independent, redundant, digital monitor modules is described. One monitor module is used for each parameter significant to reactor safety. The characteristics of a proposed liquid metal fast breeder reactor are used as the reference performance criteria. The established criterion that a single failure must not prevent reactor shut down is used as the failure mode criterion. Within the program module, a programmable read-only memory (PROM) is used for sequence control of another PROM containing variable length subroutines. The subroutine PROM outputs are used as photo-isolated logic outputs for sequence control of the various monitor modules. The program module action is modelled on a digital computer. A four-input digital monitor module is developed. This module provides a shut down signal if three of the inputs exceed the parameter limit. (auth)

21595 FLUID ACTUATORS FOR CONTROL AND SAFETY IN PRESSURE TUBE REACTORS. Broggi, A. (CCR-EURATOM, Ispra, Italy); Peterlongo, G.; Tacconi, F. A. Energ. Nucl. (Milan); 19: No. 12, 750-8(Dec 1972).

Two systems, one for fine control and the other for fast shutdown, developed and tested for the CIRENE prototype reactor are described. These systems can be used without major modifications in any pressure tube reactor. (auth)

21596 REACTIVITY WORTHS OF BORON, TANTALUM, AND EUROPIUM IN A FAST REACTOR SPECTRUM. Tuttle, R. J.; Springer, T. H. (Atomics International, Canoga Park, CA). Contract AT(04-3)-824. Nucl. Sci. Eng.; 49: No. 4, 468-81(Dec 1972).

Central reactivity worth measurements have been made in a fast reactor spectrum with samples of natural boron, boron-10, europium oxide, and tantalum. Various sized samples were used to investigate self-shielding effects in a fast reactor test region in Assembly 17 of the Epithermal Critical Experiments Laboratory. In addition to single cylinders, clusters of tantalum pins simulating a control rod segment were also used. Compared to an infinitely dilute sample, the most massive tantalum sample showed a reduction of 49 percent in reactivity per unit mass. For comparison with the tantalum measurements, extensive calculations using first-order perturbation theory, exact perturbation theory, and eigenvalue differences show good agreement within appropriate ranges–first-order perturbation for small perturbations, eigenvalue differences for large perturbations, and exact perturbation throughout the range. For europium, first-order perturbation calculations are in excellent agreement with the measurements, while for boron and ^{10}B, the calculations predict a somewhat greater worth than was measured. By using the calculations to extrapolate the measurements, the following infinitely dilute specific reactivity values are obtained: boron, –5.83 m¢/g; ^{10}B, –293.8 m¢/g; europium, –20.6 m¢/g; and tantalum, –5.83 m¢/g. (auth)

21597 NUCLEAR MEASURING DEVICES FOR NUCLEAR POWER PLANTS. Weidmann, J. (Hartmann und Braun AG, Frankfurt am Main). Energ. Tech.; 24: No. 9, 287-9(1972). (In German).

A brief survey is given of industrial instruments for: neutron flux measurements with ion chambers; area monitoring; and monitoring of exhaust air and waste water. (GF)

21598 STANDARDIZATION OF MEASUREMENTS OF NEUTRON FLUX DENSITY IN NUCLEAR REACTORS. Arabei, B. G.; Bochin, V. P.; Garapov, E. F.; (and others). Tr. Soyuznogo Nauch.-Issled. Inst. Priborostr.; No. 17, 3-8(1972). (In Russian).

Problems of standardization of means and methods of measurement of neutron field parameters in nuclear reactors in order to provide unity and correctness of measurement of these parameters are discussed. One means of standardization is the use of activation detectors. Recommendations are presented for the composition of standard sets of activation detectors. It is suggested that a "standard" source of thermal neutrons based on the F-1 graphite reactor be used to calibrate detectors used for continuous measurements in reactors. The parameters of the neutron field in the reactor (arbitrary flux density, epithermal parameter, neutron gas temperature) are measured using activation detectors with errors of from 2.5 to 3%. The use of the source described permits calibration of neutron detectors with an accuracy of from 4 to 7%. (tr-auth)

21599 NUCLEAR REACTOR CONTROL ROD. Fisher, J. R. U.S. Patent 3,712,852. 23 Jan 1973. Filed date 8 Jul 1968. 6p.

A control rod (movable or fixed) for a water moderated n ·ar reactor is described which is comprised of a plurality of t· ·r,

rectangular, or oval members which are coplanar and in parallel thus forming a blade or slab. The members are of a neutron absorbing material such as boron carbide, hafnium, silver–indium–cadmium, etc., and are spaced such that a neutron moderator as water or D_2O can flow between the members, or a solid moderator such as zirconium hydride can be placed between the members. The spacing between members can be varied axially, can be varied from one end of the blade to the other, or both. In this manner the neutron absorption rate can be shaped along the blade. Said blades may form a cruciform, Y shape, or slab and may be the movable type which can be positioned by a drive or the fixed type which can only be positioned or removed manually. Also, a control rod for a water moderated nuclear reactor is comprised of a solid blade of neutron absorber, such as hafnium, having cruciform, Y, slab shape, etc., either movable or fixed, with a series of bore holes which allow moderator to flow through the rod and thus providing neutron moderation within the rod. (Official Gazette)

21600 DEVICE TO PREVENT SODIUM FREEZING AROUND SHAFT PENETRATION. Germer, J. H. (to United States Atomic Energy Commission). U. S. Patent 3,700,551. 24 Oct 1972. Filed 18 Feb 1971.

A device is described for preventing sodium vapor from freezing around a movable shaft extending into a pool of hot sodium through a cover gas. The device consists of a sealed hollow-wall tube containing sodium positioned around the shaft in the region of possible freezing with its lower end in heat exchange contact with the cover gas. Means may be provided for passing inert gas through the annulus between the shaft and the hollow-wall tube countercurrent to sodium vapor rising from the pool of hot sodium. (auth)

Containment Systems, Shielding, Waste Processing, and Radiation Protection

21601 (NP-19655) PAINTING IN NUCLEAR POWER PLANTS. (Statens Vattenfallsverk, Stockholm (Sweden)). Apr 1971. 110p. (In Swedish). Dep. NTIS (U. S. Sales Only).

A working group has suggested guidelines for the choice and testing of paints intended for use in active parts of a nuclear power plant. About 60 brands of paints have been tested with regard to radiation resistance, ease of decontamination and chemical and physical properties, according to USASI N5.9-1967. (Sweden)

21602 RESEARCH AND EXPLOITATION OF CIVIL ENGINEERING TECHNIQUES CONCERNED WITH ATOMIC POWER PLANTS. 1. PRESTRESSED CONCRETE PRESSURE VESSELS AND CONTAINMENT VESSELS. Nagakura, T. (Central Research Inst. of Electric Power Industry, Chiba, Japan). Doboku Gakkaishi; 57: No. 2, 35-40(Feb 1972). (In Japanese).

As nuclear reactors become larger, stainless steel containment vessels tend to be replaced by prestressed concrete ones. Also prestressed concrete is employed for high-pressure and high-temperature reactor vessels, for example, for advanced gas-cooled reactors and high temperature gas-cooled reactors. The prestressed concrete pressure vessels can stand both compression and tension, and can be shielding material. They can increase safety, enable development of plants of larger capacity, and improve economy. Design standards of the vessels are not yet completely established. Analysis of vessel structure can be performed at each condition of normal operation, overload, and breakdown. The prestressed concrete reactor containment vessels do not break suddenly and scarcely crack. Design of the containment vessels depends upon total released energy, quantity of released radiation, etc in accidents. The structural analysis of the containment vessels is based on yield limit design. Mock up tests have been performed in order to check results of elastic and creep analyses, and to recognize breaking mode, ultimate strength and the safety rate at the accident. As prestressing systems, the BBRV method, the SEEE method, the CCL method, and the Freyssinet method are employed. More studies are needed to develop prestressed concrete pressure vessels of high safety corresponding to the conditions of locations in Japan. (Japan)

21603 PRESENT STATE OF INSTALLATION OF FILTERS FOR REACTOR USE: IN PWR. Oka, K. (Kansai Electric Power Co. Inc., Osaka). Kuki Seijo; 8: No. 7, 7-11(Mar 1971). (In Japanese).

Ventilation equipment in PWR power plants is divided into three major systems. They are the containment vessel ventilation system, the reactor auxiliary building ventilation system, and the central control room and personnel control room ventilation system. The containment vessel ventilation system is further divided into four subsystems, they are the containment vessel circulation and air conditioning subsystem, the annulus exhaust subsystem, the containment vessel auxiliary circulation subsystem, and the containment vessel air supply and air conditioning subsystem. The containment vessel ventilation system is one of engineered safety devices and adsorbs and removes radioactive substances from the mixture of air and steam in the containment vessels in the case of the highly unlikely fracture of the primary coolant pipe. The mixture of air and steam is passed through filters for reactor use. Details and specifications of the containment vessel ventilation system and the reactor auxiliary building ventilation system, and filters used in the ventilation systems are described. (Japan)

21604 ZOCO V, A COMPUTER CODE FOR THE CALCULATION OF TIME- AND SPACE-DEPENDENT PRESSURE DISTRIBUTIONS IN REACTOR CONTAINMENTS. Brosche, D. (Technische Univ., Munich). Nucl. Eng. Des.; 23: No. 3, 239-271 (1972).

A new mathematical model and the resulting computer code ZOCO V are described, which permits calculation of the time- and space-dependent pressure and temperature distributions in containments of water-cooled nuclear power reactors following a loss-of-coolant accident which is caused by the rupture of a main recirculation or steam pipe (MCA). With this computer code, subdivided full pressure containments as well as pressure suppression systems can be treated primarily for the short term behavior (within the first seconds from the beginning of the accident until the end of the blow-down when pressure equilibrium between primary system and containment is reached) and also for the subsequent long term behavior. This model is a multi-pressure node one whereby the number of the pressure nodes, that of the connections between them and that of the heat conducting solid structures can be arbitrarily chosen. Calculated pressure time histories were compared with corresponding experimental results for full pressure containments and pressure suppression systems and showed good agreement between theory and experiment. (auth)

21605 ESSENTIAL CRITERIA AND CONSTRUCTIVE DESIGN OF THE CONTAINMENT SYSTEM FOR BOILING WATER REACTORS. Koch, E.; Kuschel, D. (AEG–Telefunken, Franfurt am Main). Nucl. Eng. Des.; 19: No. 2, 219-314(1972). (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Germany (20 Sep 1971). See CONF-710903–(Vol.19,No.2).

The design, essential criteria and function of the containment system for AEG–Telefunken's boiling water reactor product line are reviewed. Safety enclosures of other BWR's are in most aspects similar with respect to the basic design principles. The system presented consists of a steel primary containment with pressure suppression pool protected by reinforced concrete, of a leak-tight shell around the primary containment with a reventing system, of a reinforced concrete reactor building as secondary containment and of auxiliary systems for air conditioning and filtering and for decay heat removal. A study revealed that the smallest primary containment is the most economic, because primary containment size governs reactor building dimensions. Since the same fuel elements are being used for all plants—the power being proportional to their number—, the height of the reactor pressure vessel is almost independent of thermal power. It seems possible to size pressure suppression containments nearly independently of thermal power. Therefore the limits of compact construction are shown. The design criteria presented for the overall containment system consider access to components for operation, inspection and recurring tests in order to maintain high plant availability. System lay-out under all possible loads and operating conditions as well as quality assurance is taken into account. Independence, separation and diversification of systems as well as redundancy are considered. The criteria are aimed at system and—as a consequence—environment protection under accident and, if necessary, external hazard conditions. A light is thrown on some new test results and on conservatively predicted performance of the containment system under reactor accident conditions, showing margins to keep the system safely under control even under highly degraded conditions. (auth)

21606 CONTAINMENT OF FAST BREEDER REACTORS: PRESENT STATUS AND REMAINING PROBLEMS. Fistedis, S. H. (Argonne National Lab., Ill.). Nucl. Eng. Des.; 19: No. 2, 315-31(1972).

From first international conference on structural mechanics in reactor technology; Berlin, Germany (20 Sep 1971). See CONF-710903–(Vol.19,No.2).

The containment of sodium-cooled fast breeder reactors is analyzed. The excursion phenomenon that may need containment in a hypothetical accident could initiate at the core for variety of reasons and usually, but not always, propagates inside the

primary system, first as a shock wave, second as a sodium momentum, and third as an expanding gas bubble. Primary containment pertains to the absorption and dissipation of explosive effects in the primary system. The primary containment analyses and codes already developed and currently under development at Argonne National Laboratory combine the equations of hydrodynamics with the equations of state. They start with an energy input in the core in the form of temperatures, pressures and internal energy. This is the neutronic input leading to core disassembly. This energy is propagated through the primary system and components (blankets, reflector, grid, reactor vessel, plug, etc.) in a manner so as to provide a constant inventory of the position and deformation of these components at any one time after the start of the excursion. More specifically, the codes' output is in the form of displacements (strains), pressures, velocities, accelerations, densities, and internal energies. Recently work has started to include in the energy input, the continuing effects of fuel-coolant interactions. The subject analyses and computer codes are two-dimensional. The next development step will attempt to modify these codes to provide engineering solutions for three-dimensional (asymmetric) cases. The treatment of the primary system response terminates with the possible dislocation of the reactor plug. The subject codes ultimately will provide, along with plug displacement, an inventory of sodium spillage into the secondary containment. Secondary containment pertains to the confinement of radioactive gases and aerosols which may have escaped the primary reactor system. Secondary containment must be capable of retaining its gas tightness under the pressures and temperatures resulting from sodium spillage fires. (auth)

Cooling Systems

Refer also to abstracts 19735 and 21863.

21607 (BMBW-FBK-72-18) DEVELOPMENT PROGRAM: STEAM COOLED FAST BREEDER REACTOR. Final Report, Part 3. Development of Fuel Elements. Contamination of Coolant Cycle. Ammentorp-Schmidt, F.; Basso, H. H.; Bechtel, G.; (and others) (Allgemeine Elektricitaets Gesellschaft, AEG-Telefunken, Frankfurt am Main (West Germany)). Oct 1972. 522p. (In German). Dep. NTIS (U. S. Sales Only).

The companies AEG/GHH/MAN started work for development of a 300 MW(e)-prototype of a steam-cooled fast breeder reactor in 1966 under sponsorship of the Ministry of Scientific Research (BMwF). Work was suspended prior to completion. The development and irradiation testing of prototype fuel rods is reported. Coolant cycle contamination was also studied and no problems were found. (auth)

21608 (IAE-2050) EFFECTIVE METHOD TO CALCULATE TRANSITIONAL PROCESSES IN A MULTILOOP NUCLEAR PLANT WITH A GAS COOLANT. Arifmetchikov, E. F. (Institut Atomnoi Energii, Moscow (USSR)). 1970. 24p. (In Russian). INIS.

A universal and effective method was proposed for calculating non-steady state processes in a gas-cooled nuclear plant during heat exchange between the gas and a loop wall which has internal sources (discharges) of heat. (tr-auth)

21609 (WCAP-7973) CALCULATION OF FLOW COAST-DOWN AFTER LOSS OF REACTOR COOLANT PUMP (PHOENIX CODE). Bordelon, F. M. (Westinghouse Electric Corp., Pittsburgh, Pa.). Aug 1970. 17p.

The PHOENIX code calculates the individual loop flows, core flow and pump speeds as a function of time subsequent to failure of any number of the reactor coolant pumps. Presently the analysis treats only simultaneous loop flow and impeller coast-down; however, the analysis may easily be extended to other transients, such as startup transients. Since the model is based on a "rigid water column" assumption, acoustic waves are not treated. Given several basic reactor coolant system and pump parameters, along with the initial conditions of the system, the model calculates flow rates, pressure drops and pump speeds for each loop, and flow rates and pressure drops for the core. The results are printed out at specified time intervals. Any number of reactor coolant loops are accommodated up to a maximum of six. The initial loop flows are specified individually; hence nonuniform starting flows are allowed. The allowable input values of pump speed are either full speed or stopped. Any combination of running pumps may be tripped. The analysis is terminated by an input time limit or steady-state conditions. The mathematical model in the PHOENIX code has been checked against limited experimental data and is adaptable to future modifications. (auth)

21610 SOME PROBLEMS OF OVERLAID CLADDING IN A NUCLEAR REACTOR PRESSURE VESSEL. 1. EFFECT OF POST-WELD HEAT TREATMENT ON MECHANICAL PROPERTIES OF OVERLAID CLADDING. Kodaira, Tsuneo; Namatame, Hiroshi (Japan Atomic Energy Research Inst., Tokai). Yosetsu Gijutsu; 41: No. 7, 827-36(Jul 1972). (In Japanese).

Steel pressure vessels of light-water cooled nuclear power reactors are constructed with stainless steel weld overlay liners on their inner wall. Occasional cracking in the stainless steel cladding of pressure vessel is considered as one of the problems in the development, and also maintainance, of the reactor in several countries including Japan. The effect of post-weld heat treatment on the mechanical properties of the overlay weld was studied. The tests used include the half size Charpy-V notch impact test, the micro tensile test, and the guided side bend test. The test specimens were machined from the overlaid cladding, weld-bond and base metal heat treated at 600°, 625° and 650°C for 20, 50 and 100 hours. From the results obtained, the following conclusions are drawn: (1) The decrease in ductility occurs in overlaid cladding or weld-bond, depending on the post-weld heat treatment applied. A remarkable decrease occurs in the impact property of overlaid cladding; while a considerable decrease, in tensile and bend properties, was observed in the weld-bond. (2) The post-weld heat treatment should be limited to within 20 hours at 625°C, because of an excessive decrease in ductility caused in the weld-bond by prolonged heating. (3) In order to reduce the embrittlement of overlaid cladding due to post-weld heat treatment, the Gow and Harder's empirical ratio K ($\%Cr + 4 \times \%Mn + 3\,(\%Si - 1) - 16 \times \%C/\%Ni + \frac{1}{3}(\%Mn - 1)$), Cr/Ni ratio and ferrite content in Schaeffler's diagram should be limited to below about 1.9, 2.1 and 7.5% respectively. (auth)

21611 SODIUM PURIFICATION WITH THE HOT TRAP. Borgstedt, H. U.; Frees, G.; Drechsler, G. (Kernforschungszentrum, Karlsruhe, Ger.). Atomwirt., Atomtech.; 17: No. 9-10, 506-7(1972). (In German).

Experiments for purification of sodium were conducted under the following conditions: sodium volume 60 liters; sodium current 1,600 liters/hour; zirconium volume in hot trap 500 g; zirconium surface 10,000 cm^2; and temperature of the hot trap 650°C. Measurements with electrochemical probes showed that the oxygen concentration in sodium could be lowered by two orders of magnitude in comparison with cold traps. Further lowering of oxygen concentration in sodium is not necessary for the reduction of sodium corrosion in reactor components. (H.B.G.)

21612 METHOD FOR DETERMINING REACTOR COOLANT SYSTEM LEAKAGE. Campbell, D. A.; Locante, J. (to Westinghouse Electric Corp.). U. S. Patent 3,712,850. 23 Jan 1973. Filed date 8 Aug 1969. 6p.

Indirect and direct methods are provided for determining leakage from a reactor coolant system inside the reactor containment. The indirect method relies on the comparison of quantitative measurements of a tracer, such as tritium, in the reactor coolant to the tracer in the condensate collected by the containment cooling coils to determine what part of the total collection, representing all leakage, is derived from the reactor coolant system. The direct method relies on measurements of radioactivity produced by short half-lived noble gas isotopes. Measurements at a volume control tank, which is part of the reactor coolant system, and in the containment atmosphere provide sufficient information to directly reduce the reactor coolant system leakage rate. (Official Gazette)

21613 RELEASE OF RADIOACTIVE NOBLE GASES FROM COOLANT INTO GAS BLANKETS OF BOR-60 REACTOR PRIMARY CIRCUIT. Gryazev, V. M.; Konyashov, V. V.; Polyakov, V. I.; Chechetkin, Yu. V. At. Energ. (USSR); 33: No. 6, 965-968 (Dec 1972). (In Russian).

Data on spectrometric investigation of the distribution of radioactive noble gases (RNG) in the BOR-60 reactor primary circuit are presented. The isotopic composition of RNG at 3% burnup indicates that the fuel elements are air tight. Using experimental values of RNG specific activities, coefficients characterizing the probability of leakage from the coolant into the gas blankets of the reactor and pump were calculated. The control of all recorded isotopes of ^{235}U fission gas products and comparison with ^{23}Ne showed that the coefficients characterizing probability of radioactive noble gas leakage into the reactor gas blanket is about $1 \cdot 10^{-1}$ hr^{-1} and into the pump gas blanket about 1.2×10^{-2} hr^{-1}. Thus, the sodium coolant retains most of the radioactive noble gases. The amount of argon in the sodium (400°C) was estimated to be about $4 \cdot 10^{-6}$% wt. (auth)

21614 INCIPIENT BOILING PRESSURE PULSE OF SODIUM UNDER FORCED CONVECTION BY DIRECT HEATING. Takahashi, K.; Fujii-e, Y.; Suita, T. (Osaka Univ.). J. Nucl. Sci. Technol. (Tokyo); 9: No. 12, 728-736(Dec 1972).

Experiments performed in a forced convection loop on pressure

pulses imparted by the incipient boiling liquid sodium are described. The sodium was heated by direct current applied to the liquid metal in a vertical tube of 14.9 mm ID through which the medium was pumped. The experiments were carried out with the following ranges: input power of 6 to 12 kW; pressure at condenser of from 0.6 to 1.0 kg/cm^2; inlet temperature of 780 to 850°C, and flow rate of 1.0 to 3.5 l/min. Typical pressure pulses registered during incipient boiling presented the form of damped oscillation. The initial pressure pulses were dependent on the location of boiling inception along the test section, the incipient boiling pattern, and the degree of superheat. The initial pressure pulses observed were in the range of from 0 to 3.5 kg/cm^2. The pressure pulses increased with the degree of superheat, which ranged from 0 to 150°C. The magnitudes of the pressure pulses exceeded the saturation vapor pressure corresponding to the temperature of superheated liquid. Consideration of a simplified model indicated that, during incipient boiling, the pressure in the vapor phase oscillates while approaching asymptotically the saturation pressure. (auth)

21615 COOLANT RADIOACTIVITY OF THE BOR-60 REACTOR. Kobzar, I. G.; Konyashov, V. V.; Lisitsyn, E. S.; (and others). At. Energ. (USSR); 33: No. 6, 991-992(Dec 1972). (In Russian).

Special sodium and gas spectrometric loops and detectors were arranged in the BOR-60 reactor to provide information on the radioisotopes in the sodium coolant and in the cover gas. The radioactivity of the sodium coolant in Ci/kg of Na was monitored over long periods of time for the presence of ^{22}Na, ^{110m}Ag, ^{65}Zn, ^{86}Rb, and ^{125}Sb. The results did not agree with those calculated from an assumed operation with hermetically sealed fuel rods and those values stemming from experience with other reactors. (KSW).

Fuel Systems and Components

Refer also to abstract 19757.

21616 (AEEW-R-748) LOCAL HEAT FLUX VARIATIONS AND BURNOUT WITH HETEROGENEOUS NUCLEAR REACTOR FUEL. Knowles, J. B.; Fox, P. F. (Atomic Energy Establishment, Winfrith (England)). Jun 1972. 58p. Dep. NTIS (U. S. Sales Only).

In certain circumstances, the fuel pins in a nuclear reactor may contain a random dispersion of higher enrichment inclusions within a body of fuel material of a nominal enrichment. These inclusions produce heat flux perturbations at the outer surface of the fuel can, which in the case of a water reactor affect the burnout risk. A simplified point source approximation which exaggerates the amplitude of the heat flux perturbations is used to obtain their statistical characteristic function. In conjunction with an approach which regards a burnout correlation as giving an assessment of burnout probability, and a local conditions burnout hypothesis, this characteristic function is used to derive the burnout risk with heterogeneous fuel. Two typical fuel specifications are used to illustrate the analysis. 16 references. (UK)

21617 (BLG-467, pp 1.1-58) DEVELOPMENT OF FAST REACTORS.

BELGIAN REACTOR-2—irradiation facilities for, development of fast
PLUTONIUM OXIDES PuO_2—PuO_2–UO_2, development of fast reactor fuels of
—PuO_2–UO_2, reprocessing of fast reactor fuels of
REACTOR FUEL ELEMENTS—cladding for fast, development of
REACTOR FUELS—development of fast, 1971 support activities for
REACTORS, FAST—development of, 1971 support activities for
REACTORS, LIQUID METAL COOLED—development of, 1971 support activities for
SNR REACTOR—development of, 1971 support activities for
SODIUM—properties for use as fast reactor coolant
URANIUM CARBIDES—development of fast reactor fuels of (HDR)

21618 (CONF-721112-7) LIQUID ENTRAINMENT RATE AND DROPLET SIZE RELATIVE TO FUEL FAILURE PROPAGATION DUE TO FISSION-GAS JET-IMPINGEMENT IN LMFBR SUBASSEMBLIES. Chawla, T. C. (Argonne National Lab., Ill.). 1972. 16p. Dep. NTIS.

From American Society of Mechanical Engineers Winter Meeting; New York, New York, United States of America (USA) (26 Nov 1972).

The Kelvin–Helmholtz instability of the gas-liquid interface of sonic gas jet submerged in a mass of a viscous liquid is studied in order to determine the rate of liquid entrainment as well as the droplet size resulting from tearing off the liquid from the unstable liquid surface. The determination of the size of the droplets and the rate of liquid entrained is required in formulating a correlation for the heat transfer coefficient in the spray-cooled region of the fission-gas jet-impingement area in LMFBR subassemblies. The linear hydrodynamic stability of the gas-liquid interface under the action of the pressure perturbations, the interfacial surface tension, and the finite liquid viscous forces, is considered. For fission gas jets with values for the ratio between radius and wavelength of the disturbance much greater than one, a short-wave approximation to the dispersion equation for the instability is obtained. Approximate solutions for the growth parameters of the wave having maximum growth rate both for the case of inviscid liquid and highly viscous liquid are obtained; the exact solution for liquids having a finite viscosity is also presented. (auth)

21619 (GEAP-10221-11) DEFICIENT COOLING. Eleventh Quarterly Progress Report, January 1–March 31, 1972. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Apr 1972. Contract AT(04-3)-189. 23p. Dep. NTIS.

The 8600-kW ATLAS heat transfer facility and the 16-rod test section and bundle are described. Operation with the first 16-rod bundle produced no useful data due to electrical shorting between heaters and grid spacers. The test bundle was rebuilt with more compatible materials, and testing will be completed in the following quarter. The one-rod swell heater was redesigned, to avoid brazing difficulties, and testing will be completed in the following quarter. (auth)

21620 DETECTION AND LOCALIZING OF BURST SLUGS IN NUCLEAR REACTOR FUEL ASSEMBLIES. Backs, H.; Cauvin, J. C.; Jarretou, H.; Prouteau, L. (to Commissariat a l'Energie Atomique). French Patent 2,112,077. 16 Jun 1972. Filed 22 Sep 1970. (In French).

A device for detecting and localizing burst slugs in the fuel assembly of a nuclear reactor cooled by a pressurized liquid is presented. The device possesses an array of tubes for sampling the coolant and guiding the coolant away from the outlet of a fuel assembly channel, this coolant flowing under its own pressure into a degassing and gaseous fission product extraction system. The tubes are positioned in a regular network forming a criss-cross lattice. A sampled material selector enables the fission products from a given line or column to be selected. This device is suitable for nuclear reactors in which the vessel containing the reactor core is filled with a coolant liquid which circulates in the core channels containing the fuel assemblies. (FR)

21621 OPTIMAL FUEL ENRICHMENT DISTRIBUTION IN FAST REACTORS. Goldschmidt, P. (Electrobel SA, Brussels). Nucl. Sci. Eng.; 50: No. 2, 153-163(Feb 1973).

A model is presented which enables us to find the distribution of fuel enrichment that minimizes the fuel cycle cost of a fast reactor, subject to constraints on the enrichment, power, and power density. The reactor is described by a discontinuous one-group diffusion model in slab geometry. Making use of Pontryagin's Maximum Principle, as extended by Gossez and by Vincent and Mason, the optimal sequence of control (enrichment) zones is found a priori. The latter consists of a central constant power density zone, a maximum enrichment zone, a minimum enrichment zone, and a reflector. The numerical solution of the problem is based on an automatic double iteration search procedure requiring no input trial function. Under the economic conditions considered, it seems preferable to start up the first fast breeder demonstration plants with a core surrounded by reflector elements; radial blanket subassemblies should be inserted only later, and progressively, when fabrication costs decrease and the operational knowledge improves. (auth)

21622 IN-CORE FUEL MANAGEMENT OPTIMIZATION BY HEURISTIC LEARNING TECHNIQUE. Hoshino, Tsutomu (Kyoto Univ., Uji, Japan). Nucl. Sci. Eng.; 49: No. 1, 59-71 (Sep 1972).

The optimization of the multistage refueling decision process was studied by the heuristic approach for four-region batch refueling including shuffling. The current state of the process is assumed to be well characterized by so called heuristic features, as excess reactivity or peaking factor. The features are summed up with each weight, defining the decision evaluation function which should be maximized at each refueling by the best decision. Thus the final criterion, i.e., the average discharge burnup at the end of the whole reactor life can be regarded as a function of the weight and is maximized in the weight space by the hill climbing algorithm. The approach can also be interpreted as an attempt to determine, through learning, the general importances of the rules of thumb in the refueling policy as maximization of the ex-

cess reactivity or power flattening. A numerical simulation is given, and the maximum burnup, the refueling scheme, and the optimal weight are discussed in relation to the power-peaking factor constraint. Though the method is not guaranteed as for the optimality, reasonable solutions are obtained and the intuitive understanding of the process is possible by discussing the optimum weight of each rule. (auth)

21623 ANODIC DISGREGATION OF AVR MOCK-UP FUEL ELEMENTS: PERFORMANCE OF A NEW ELECTROLYTICAL CELL. Beone, G.; Lazzaretto, G.; Moccia, A. (CNEN, Rome). Energ. Nucl. (Milan); 19: No. 10, 620-6(Oct 1972).

Head-end treatment of HTGR spent fuels includes anodic disgregation as one of the possible processes to remove structural graphite from coated particles. Disgregation tests carried out on AVR mock-up fuel elements in purposely designed electrolytical cell are described. They showed that separation is feasible at a rate of about 100 g of fuel per hour, with a yield of 0.8 g/A·h, less than 1% of graphite being entrained by particles. The best working conditions were found in 6 M HNO_3 at a 35°C temperature and a 0.6 A/cm² cathodic current density. 9 references. (auth)

Auxiliary Systems, Protection Systems, and Engineered Safeguards

Refer also to abstract 20202.

21624 BASE-BORATE REACTOR SAFETY SPRAY SOLUTION FOR RADIOLYTIC HYDROGEN SUPPRESSION. Zittel, H. E.; Lupica, S. B.; Bate, L. C. (to United States Atomic Energy Commission). U. S. Patent 3,691,084. 12 Sep 1972. Filed 19 Apr 1971.

A new composition of an aqueous solution of sodium hydroxide containing up to 3,000 ppM boron as the borate is provided. The solution has a pH in the range 5.8 to 12.1, and contains a reagent selected from the group consisting essentially of Na_2MoO_4, Na_2CrO_4, Na_2WO_4, and $NaVO_3$ at a concentration which is effective to suppress hydrogen formation resulting from irradiation of the solution in a nuclear reactor. (auth)

21625 PRESENT STATE OF INSTALLATION OF FILTERS FOR REACTOR USE. PROBLEMS ASSOCIATED WITH INSTALLATION OF FILTERS FOR REACTOR USE. Ishimoda, T. (Shin Nippon Air Conditioning Co. Ltd., Tokyo). Kuki Seijo; 8: No. 7, 15-19(Mar 1971). (In Japanese).

The first requirement for filters for reactor use is to eliminate bypassing and leakage of air. The next requirement is to construct the filters so that contaminated filters can be easily replaced and that personnel are protected from radiation hazards. Various aspects of the installation of filters at the Fukushima nuclear power station are discussed. (1) Uniform distribution of air mass flow on air filter surfaces. (2) Selection among various types of arrangement of the filters. (3) Working area for replacement of the filters. (4) Manholes for maintenance and inspection. (5) Lighting. (6) Air tight and pressure resistant casings. (7) Filter frames and bypassing leakage of air. (8) Floor drain. (9) Position of draft fans and flexible joints. (10) Gauges for measurement of pressure differences across the filters. (Japan)

Operation and Economics

Refer also to abstract 21853.

21626 PMC DIGS IN TO BUILD THE BREEDER. Schuster, Ray (ed.). Power Eng.; 77: No. 1, 42-47(Jan 1973).

Administrative activities involved in the construction of the demonstration LMFBR are described. Quality assurance requirements are discussed. Financial data concerning the demonstration LMFBR are included. (DCC)

21627 STEAM ACCUMULATORS FOR ECONOMIC PEAK LOAD COVERAGE WITH NUCLEAR POWER PLANTS. Beckmann, G. (Waagner-Biro AG, Vienna); Gilli, P. V. Atomwirt., Atomtech.; 17: No. 9-10, 503-4(1972). (In German).

Described is a project study on steam accumulators for the coverage of peak loads in nuclear power plants. Arrangement of the installation is schematically depicted and thermal data as well as construction data are tabulated. A cost analysis shows that the steam accumulators are economically superior to conventional means for peak load coverage. (HBG)

21628 NUCLEAR INDUSTRY IN EUROPE. RESULTS OF A FORATOM STUDY. Edler, Erika; Nauheim, Bad. Atomwirt., Atomtech.; 17: No. 9-10, 508-11(1972). (In German).

The European atom forum concluded a study about the nuclear industry of the FORATOM member countries. The most important results were compiled. Projections up to 1980 show that high demands will be put upon the European industry in regard to production and supply capabilities. Fulfillment of the demands will strain all efforts. In comparison with the USA, the isolation of European national economies leads to overcapacity in many special areas. This fractionation will permit economically favorable operations only in a few cases. (tr-auth)

21629 TECHNOLOGY ASSESSMENTS FOR DEVELOPMENT OF DEMONSTRATION FAST BREEDER REACTOR. Nakagawa, H.; Tsukizi, M. (Tokyo Electric Power Co. Inc.). Genshiryoku Kogyo; 18: No. 1, 36-41(Jan 1972). (In Japanese).

Estimated fuel cycle costs and construction costs of 1500 MW(e) commercial FBR plant are given. The estimation was based on design studies conducted by TEPCO in co-operation with Japanese plant builders and on results of USAEC's "1000 MWe FBR Follow-on-Study." Economical and technological assessments of various design alternatives are given. These include: (1) High core-height is desirable from view point of the fuel cycle cost, and only a portion of money saved may be sufficient to equip instrumentation systems for control of large sodium-void-reactivity. (2) Economical merits of using vented fuel are related with breeding ratio, fissile inventory, maximum temperature of fuel cladding, and volume of reactor vessels. Use of He as the cover gas is also suggested. (3) As for the steam system, merits and demerits of reheat and non-reheat types are discussed. (4) As for the refueling system, advantages of the hot cell type are discussed from the viewpoints of refueling time and reactor containment. (Japan)

21630 OPTIMIZATION STUDIES FOR THE INCORE FUEL MANAGEMENT OF LIGHT WATER REACTORS WITH A SIMPLIFIED MODEL. Mueller, E. (INTERATOM, Bensberg, Ger.). Atomkernenergie; 20: No. 2, 122-6(Oct 1972). (In German).

A simplified system of equations is developed which under specified assumptions describes the interrelation between reactivity, power distribution and burnup for the equilibrium cycle of a light water reactor. These equations are then used to determine conditions necessary for a fuel management program and for power and burnup distributions which for a preset final burnup lead to the highest reactivity at the end of the cycle or to the lowest enrichment for the fresh fuel assemblies. The results will be carried over to the more general problem of optimizing fuel cycle costs. (auth)

Safety and Siting

21631 (AEC-tr-7357) EMERGENCY COOLING PROGRAM. High-Pressure Section of Emergency Cooling Testing Carried Out on Pressurized Water Reactors (PWR) and Boiling Water Reactors (BWR). First Semi-Annual Report, January–June 1971. Agemar, F.; Bohlaender, H.; Brand, B.; Brunswick, J.; Hicken, E.; Kohler, L.; Saelzer, H. G.; Schad, O.; Schroeneberg, R.; Schueler, M. (Allgemeine Elektricitaets-Gesellschaft, Frankfurt am Main (West Germany)). Translated by W. J. Grimes from report AEG-E-3-2057. 134p. Dep. NTIS.

Experimental investigations are provided within the scope of the emergency cooling program for support of the analytical investigations of heat transfer in the reactor core with coolant loss. Breakdown conditions in the reactor are extensively simulated by blowdown testing with an internally streamed pipe and multiple-rod bundles. Controlled bundle measurements on multiple-rod bundles enable testing of the computer model by withdrawal of designated transients. A circulation system is set up especially for blowdown testing. This system is to be used chiefly for the tests on the internal flow pipe and subsequently will be extended for the planned four-rod bundle tests. The flexible setup of the test bed allows the effects of various parameters such as filament power, break cross section, location of the break, mass flow, resistances to flow and undercooling to be determined. (auth)

21632 (AEC-tr-7359) SAFETY ANALYSIS PLAN: USE OF VARIOUS SAFETY AND RELIABILITY ANALYSES AT THE RIGHT TIME AND ON SPECIAL PROBLEMS. Balfanz, H. P. (Technischer Ueberwachungs-Verein e. V., Cologne (West Germany). Institut fuer Reaktorsicherheit). Translated from report IRS-W-2. 29p. Dep. NTIS.

A survey of the present status of reactor safety and reliability analyses is presented. Eight different types of safety analyses are described. 23 references. (auth)

21633 (HEDL-SA-480) SYSTEM FOR TRAINING AND SUPERVISING QUALITY ASSURANCE REPRESENTATIVES WHO PERFORM SOURCE SURVEILLANCE FOR NUCLEAR REACTOR CORE COMPONENTS. Stranik, D. A. (Wadco Corp., Richland, Wash.). 1972. 82p. Dep. NTIS.

Thesis. Submitted to Univ. of Washington, Seattle.

Quality assurance source surveillance of nuclear reactor core components is being used more today because of the Atomic Energy quality assurance requirements. In order to perform source surveillance personnel are required to be trained. In addition to adequate training programs, a good management system for supervising the quality assurance representatives is needed to help provide for more efficient and effective source surveillance. Developing a training program and a mangement system was undertaken. The proposed training program and management system were developed based upon the results of a questionnaire sent out to companies in the nuclear business, through the author's personal experience and through courses which were identified in the literature. The training program outlines minimum requirements for education and experience factors of personnel, formal training necessary, and on-the-job training for quality assurance representatives. The basic elements of a management system which can be used to help develop more efficient source surveillance are also outlined. (auth)

21634 (WCAP-8004) TOPICAL REPORT: SAFETY RELATED RESEARCH AND DEVELOPMENT FOR WESTINGHOUSE PRESSURIZED WATER REACTORS; PROGRAM SUMMARIES, FALL 1972. (Westinghouse Electric Corp., Pittsburgh, PA). 1972. 60p.

Descriptions of the safety related Research and Development Programs which are being carried out for, or by, or in conjunction with, Westinghouse Nuclear Energy Systems (WNES), and which are applicable to Westinghouse pressurized water reactors (PWR) are presented. For each program still in progress the safety related problem is first introduced; followed, where appropriate, by background information. There is, then, a description of the program which relates the program objectives to the problem and presents pertinent recent results. Finally, a back-up position is stated for programs—generally experimental rather than analytical—which have not yet reached a stage where it is reasonably certain that the results confirm the expectation. The back-up position is one that might be used if the results are unfavorable; it is not necessarily the only course that might be taken. (auth)

21635 CIVIL ENGINEERING AND CONSTRUCTION OF NUCLEAR REACTOR FUGEN. Tanaka, K. (Electric Power Development Co. Ltd., Tokyo). Genshiryoku Kogyo; 18: No. 3, 27-32(Mar 1972). (In Japanese).

The construction of the nuclear reactor "Fugen" is described. The construction was started in 1970, and ground levelling was finished. Excavation for plant houses is now underway and is to be succeeded by construction of some reinforcing works, and final placing of the base mat for the plant buildings. The most economical level for the buildings was decided as 20m above sea level. The whole construction is programmed to be completed by the middle of 1974. The base rock of the site is granite which has some defects due to intercalated clay seams, and groundwater seepage. Serious attention has been given, therefore, to the safety of the nuclear reactor, pressure tunnels, slope cuttings, etc. The main buildings are the reactor house, its auxiliary building, the turbine house, and the pool house for fuel storage, and the first is ranked as A and others as B, C in earthquake-proof grades. In the earthquake-proof design of A class buildings, both dynamic and static analyses are carried out, and the values are taken from the obtained values by both analyses. Most of the buildings are to be erected directly upon the granite. (Japan)

21636 TECHNICAL PROBLEMS OF MULTI-PURPOSE LIGHT WATER REACTOR. SAFETY PROBLEMS OF MULTI-PURPOSE NUCLEAR PLANT. Kimura, T. (Electric Power Development Co. Ltd., Tokyo). Genshiryoku Kogyo; 18: No. 4, 29-33(Apr 1972). (In Japanese).

Safety problems of multi-purpose nuclear plants were studied with reference to the Midland plant in America and the BASF plant in West Germany. The safety of nuclear plants is maintained according to standards for location of the plants. But as for the safety of other plants, there is no such standard. Since it is more economical to locate the other plants near large cities it is desirable for nuclear plants themselves to be located near the large cities. Accordingly the problems of securing lands required must be taken into consideration. When the nuclear plants are close to petrochemical plants, accidents of explosion and leakage of poisonous gases in the chemical plants disturb operation of the nuclear plants, and interruption of electric power disturbs control of the chemical plants. The influence of the nuclear plants on the other plants is radiation contamination. Radiation protection for both products and workers at the plants must be performed sufficiently. For example, in the Midland plant, the steam supply is stopped at the moment radiation intensity in the process steam is two times as large as that of background. (Japan)

21637 "CALCULATED" LOSS-OF-COOLANT ACCIDENT: A REVIEW. Ybarrondo, L. J.; Solbrig, C. W.; Isbin, H. S. AIChE Monograph Series, Number 7. New York; American Institute of Chemical Engineers (1972). 100p.

Present calculational procedures used for predicting the thermal and hydraulic response of commercial power reactors to a loss-of-coolant accident are reviewed. The design configurations of present generation PWR and BWR reactor coolant systems are summarized to provide a basis for discussing the analysis methods. Computational models required for each phase of the accident are reviewed and the required interfacing of these various analysis models is described. A basic scheme for the analysis of certain hypothetical accidents is described and the need for a continuing development of methods is pointed out. (auth)

21638 MECHANICAL FAILURES OF NUCLEAR AND CONVENTIONAL COMPONENTS IN NUCLEAR POWER PLANTS. Feldmann, J. (Abteilung Technische Versicherungen, Munich). Nucl. Eng. Des.; 19: No. 2, 207-19(1972). (In German).

From first international conference on structural mechanics in reactor technology; Berlin, Germany (20 Sep 1971). See CONF-710903-(Vol.19,No.2).

Following on a short consideration of experiences gained with failures occurring during the erection of nuclear power plants, a survey of the experienced operational failures with nuclear power plants is given. The investigation is based on the analysis of publicized descriptions of operational and failure experiences with 8 BWR power plants, 9 PWR power plants, and 13 gas-cooled power reactor plants. The compilation only considers nuclear power plants larger than 100 MW(e) in capacity. In total 145 failures in the nuclear and conventional parts of the power systems have been analyzed. An analysis of some individual failure events and repairs is given. The causes and types of failures occurring in nuclear power plants are not essentially different from those occurring in conventional plants. It is shown that repairs can also be done on highly activated system components inside of steel and prestressed concrete reactor pressure vessels. However, such repairs require about a 10-fold time period as compared with the execution of similar repair works which are not influenced by radiation fields. (auth)

21639 FAILURE EXPERIENCE AS A TOOL FOR EVALUATION OF NUCLEAR STRUCTURES. Bender, M. (Oak Ridge National Lab., Tenn.). Nucl. Eng. Des.; 19: No. 2, 221-36(1972).

From first international conference on structural mechanics in reactor technology; Berlin, Germany (20 Sep 1971). See CONF-710903-(Vol.19,No.2).

High reliability in nuclear structures is attainable only because previous failure experience with comparable installations can be factored into structural evaluations in such a way that unsatisfactory experience is forestalled. The use of corrective techniques to eliminate in-service faults in consumer products as a means of improving the characteristics of future products is a well-known quality control principle. This principle is only applicable to nuclear structures if the nature and causes of structural failure are fully understood. The development of some well-established structural practices that evolved through the correlation of failure experience with structural evaluation methods is discussed. Attention is then directed to the use of analogous experience in nuclear applications as an approach to the attainment of suitable structural failure characteristics. A recognized shortcoming in the use of failure experience as a basis for judging structural adequacy is the paucity of statistical data to support the evaluation process. The use of calculational and experimental methods that simulate failure characteristics as a substitute for real experience is a valuable adjunct to such statistical data. The correlation between actual failure experience and simulation techniques is set forth as a crucial feature of nuclear structural evaluations with careful interpretation of actual failure causes and effects as the prime control on structural evaluation methods. (auth)

21640 PROBABILISTIC ASSESSMENT OF AIRCRAFT HAZARD FOR NUCLEAR POWER PLANTS. Chelapati, C. V. (Holmes and Narver, Inc., Los Angeles); Kennedy, R. P.; Wall, I. B. Nucl. Eng. Des.; 19: No. 2, 333-64(1972).

From first international conference on structural mechanics in reactor technology; Berlin, Germany (20 Sep 1971). See CONF-710903-(Vol.19,No.2).

As part of a general probabilistic safety analysis, the risk of structural damage to a nuclear power plant from aircraft crashes has been evaluated in a quantified manner. Frequency distributions of aircraft speed and weight and engine weight were constructed for small and large aircraft and for site locations adjacent to and remote from an airport. Based upon United States data an analysis of aircraft accidents is presented to establish the probability of an aircraft hitting a nuclear power plant. If an aircraft hits a building, either the whole building or just the local component may respond. It is shown that the response of the entire reactor building is neg-

ligible, and the damage to specific structural components is of concern. Components of a reactor building may experience structural damage in several modes as a result of an aircraft crash. It is essential that all modes of damage for any particular component are considered to establish the critical mode of damage. Further, depending upon various parameters involved, the critical mode of damage may vary for different components. For the specific case of an aircraft striking a reactor building, three modes of damage could be delineated. The aircraft engine might perforate the structural component. This type of damage is classified as perforation mode of damage. The second mode is classified as collapse mode of damage, where a local collapse of the structural system occurs. The third mode is classified as a cracking mode of damage, where the structural component ceases to function satisfactorily after the impact due to cracking. The 18-inch thick reinforced concrete sidewall of a typical boiling water reactor plant located at the top floor of the reactor building is used as an example. The probability of damage to this sidewall in the perforation and collapse modes is investigated. The results are compared to those obtained for the cracking mode of damage. Available empirical formulas for perforation of concrete are examined, and new formulas are proposed to cover the range of parameters encountered in aircraft engine impact. Uncertainties in formulation are discussed, and the probability of damage by this mode is determined using Monte-Carlo methods. The conditional probability of local collapse of the wall panel is evaluated by using probabilistic approaches and yield line theory. The striking location (and thus the critical yield pattern), moment, and rotational capacities are all treated as random variables. The probabilities of damage under the perforation and collapse modes are approximately of the same order of magnitude. Under the impact of an aircraft, the cracking mode of damage is estimated using elastic analyses. Solutions are obtained using a finite-element idealization and considering the maximum reactive force due to an aircraft strike as a static load. For the 18-inch wall under consideration, it is predicted that the cracking mode of damage occurs much earlier than the other two modes of damage. It is shown that the impact load level predicted for cracking mode of damage is very conservative. After a study of all modes of damage, it is concluded that the aircraft risk is usually acceptably low for the typical case studied here. (auth)

Commercial Power Reactors

Physics and Core Engineering

21641 NEUTRON BEHAVIOR IN CLUSTER-TYPE FUEL LATTICES. I. EXPERIMENTAL METHOD AND RESULTS. Hachiya, Yuuki; Hatakenaka, Haruo (Sumitomo Atomic Energy Industries, Ltd., Tokai, Japan). J. Nucl. Sci. Technol. (Tokyo); 9: No. 11, 629-41(Nov 1972).

Lattice parameters δ^{28}, δ^{25}, ρ^{28} and C* were measured on cluster-type fuel lattices of the ATR (Advanced Thermal Reactor) by using a two region critical facility (D_2O-cluster test and H_2O-rod driver regions). Their dependence on lattice pitch, coolant-void ratio and fuel composition (whether UO_2 or PuO_2-UO_2) has been made clear by this experiment. A foil handling technique has been developed for determining the lattice parameters of the PuO_2-UO_2 fuel pins. The effects of the Cd-filter and of the presence of UO_2 buttons in the measurement of ρ^{28} and δ^{25} were studied experimentally and correction factors have been determined. A method of observing the spatial distribution of the γ-ray source in an activated foil has been developed, and the relation between the spatial distribution and the coincidence counting efficiency of the foil has been examined. 14 references. (auth)

Control Elements, Systems, and Instrumentation

21642 (ZJE-126) EXPERIENCE WITH THE DEVELOPMENT OF A URANIUM CALORIMETER FOR NUCLEAR REACTORS. Kott, J.; Jirousek, V.; Teren, S.; Nemec, J.; Dach, K.; Radak, B. (Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Construction Dept.). 1972. 25p. Dep. NTIS (U. S. Sales Only).

The theoretical and experimental problems associated with the measurement of heat generated in the fissile material of the Czechoslovak A-1 power reactor core are discussed. The effects of fast neutrons, photon field, and fission on the resulting heating of the samples are also discussed. A brief description of the experimental calorimeter, the results obtained with it on the RA reactor in Yugoslavia, and some conclusions are presented. (auth)

21643 DESIGN AND IMPLEMENTATION OF A FAIL SAFE ON-LINE COMPUTER CONTROL SYSTEM FOR DUNGENESS B POWER STATION. Williams, J. R. (Atomic Power Constructions Ltd., Sutton, Eng.). pp 121-6 of Trends in On-Line Computer Control Systems. London; Inst. of Electrical Engineers (1972).

From Conference on trends in on-line computer control systems; Sheffield, England (18 Apr 1972). See CONF-720449.

The data processing system (D.P.S.), which is incorporated as a central feature of the control and instrumentation of the station, is described. It presents plant data and alarm information to the operator and, in addition, carries out a number of plant control functions. The degree of dependence on the D.P.S. during normal on-load plant operation requires that the direct digital control loops be designed to high standards of integrity and failure-to-safety. Failures of the control loops must be reduced to an economic minimum. It is also essential that, if failures do occur, the fault shall not directly lead to a plant disturbance which could cause plant damage or result in an unwanted plant shutdown. Hardware design and software design for system integrity are described. (UK)

21644 ONLINE COMPUTERS IN POWER STATIONS. Jervis, M. W. (Central Electricity Generating Board, Cheltenham, Eng.). Proc. Inst. Elec. Eng. (London); 119: No. 8R, 1052-76 (Aug 1972).

The differing conditions for online computers in nuclear and thermal stations are identified. These lead to different reliability specifications and scopes of requirements. The role of the computer in alarm and data display, logging and control is outlined, and the available hardware and software techniques are reviewed. The systems engineering and planning of projects are considered in relation to the specifications of hardware and software and their production, system testing and installation at the site. The relationship of these activities to the main power-station-erection program is summarized. A method of specifying the system reliability is given, and the requirements are interpreted in terms of the system configuration with the use of redundancy. Schemes employing multiple central processor units and interconnecting highways are described, and some availability figures are reported for systems in service. The safety implications of using computers and the problems of operator-computer communication are summarized. Details are tabulated of the duties and hardware of some UK power-station computer systems, and an indication is given of the directions that may be taken by future developments. (auth)

21645 MINICOMPUTERS TO CONTROL NUCLEAR GENERATING STATION. Can. Electron. Eng.; 16: No. 9, 27-8(Sep 1972).

Ontario Hydro has ordered eight Varian 620f minicomputers to control Bruce Generating Station. Features of the minicomputers include: rapidly accessible disc memory storage, analogue and digital input-output systems, cathode ray tubes, keyboard printers, and very rapid electrostatic lineprinters. The functions of the minicomputers will be to: monitor and control all regulating mechanisms governing power, boilers and steam pressure, turbine run-up, and electrical loading; monitor temperatures and switchboard alarms; provide overall plant control for electrical power output; conduct mapping of neutron flux and data logging. (CANADA)

Cooling Systems

Refer also to abstract 20266.

21646 ADVANCED-CLASS BOILER FEED PUMPS. Conference Held in London, England, September 15-17, 1970. Proc. Inst. Mech. Eng. (London); 184: Pt. 3N, 1-155(1969). (CONF-700984).

Eleven papers were presented dealing with the application, design, development and operation of high-pressure pumping equipment for feeding the boilers in large electricity generating stations including nuclear plants. Practices and requirement of pump users and the various interpretations of these requirements by pump designers were examined. Separate abstracts are presented for four of the papers. (UK)

For abstracts of individual papers see: 21647 through 21650.

21647 FEED PUMP DESIGN CONCEPT FOR 660MW GENERATING SETS. Richardson, J. (Weir Pumps Ltd., Alloa, Eng.); Taylor, J. M. Proc. Inst. Mech. Eng. (London); 184: No. 3N, 1-10(1969).

From Advanced-Class Boiler Feed Pumps Conference; London, United Kingdom of Great Britain and Northern Ireland (UK) (15 Sep 1970).

See CONF-700984-.

A new pump design was produced to meet the requirement of the Central Electricity Generating Board for 660-MW units. Emphasis was given to the utmost reliability. In the event of failure, however, the entire pump could be removed and replaced

with a spare pump within 8 hours. A new support system, with integral pump- and pipe-handling equipment, was developed. The principal considerations leading to this design are described and details are given of the prototype pump built to prove the concept, the supporting research and development, and early operational experience. The design study was based on the Hinkley Point "B" specification for boiler feed pumping plant. (auth)

21648 BOILER FEED PUMP DESIGN FOR MAXIMUM AVAILABILITY. Weldon, R. (Sulzer Brothers Ltd., Leeds, Eng.). Proc. Inst. Mech. Eng. (London); 184: No. 3N, 18-35(1969).

From Advanced-Class Boiler Feed Pumps Conference; London, United Kingdom of Great Britain and Northern Ireland (UK) (15 Sep 1970).

See CONF-700984-.

With increasing size of turbo-generator sets, the criterion of maximum availability for boiler feed pumps has assumed even greater importance. Capital cost, power consumption, and availability are all necessary considerations in the economic optimization of power-generation equipment design. The capital and running costs of the boiler feed pump are relatively small compared with the plant for which it is an auxiliary. However, such plant depends implicity on the reliability of the boiler feed pump. Awareness of these overall economic considerations has led to the maximum availability design concept for large boiler feed pumps. A high-speed, rigid-rotor design concept has been evolved which permits the machine to continue in satisfactory mechanical operation under vapor-locked conditions. A new cartridge principle of pump construction has been introduced, wherein the complete internal assembly, incorporating end covers and bearings, is withdrawn as a single unit leaving the casing in situ. The extensive research and development carried out to prove the individual features of the design are fully described, together with particulars of the complete prototype machine, which is believed to be the highest stage pressure boiler feed pump in commercial operation in any power station throughout the world. (auth)

21649 DEVELOPMENT OF A SINGLE-STAGE BOILER FEED PUMP FOR NUCLEAR POWER STATIONS. Gasiunas, A. A. (Mather and Platt Ltd., Manchester, Eng.). Proc. Inst. Mech. Eng. (London); 184: No. 3N, 48-59(1969).

From Advanced-Class Boiler Feed Pumps Conference; London, United Kingdom of Great Britain and Northern Ireland (UK) (15 Sep 1970).

See CONF-700984-.

An unparalleled increase in the output of power-generating units in the last decade has made it necessary to reconsider the established boiler feed pump design philosophy. A number of design aspects which are of vital importance for the future development of a modern high head per stage boiler feed pump are considered. The pressure and depression pulses that are generated when impeller vanes travel past the stationary vanes of guide equipment are discussed. It is considered that these pressure fluctuations can cause cavitational damage in the impeller and other parts, and also the uneven running of a pump. The influence of geometrical and hydraulic non-symmetry on radial forces in a double volute casing is dealt with. Test results of a double suction model boiler feed pump are presented, including descriptions of durability runs with paint-coated hydraulic surfaces. (auth)

21650 SINGLE-STAGE HIGH-SPEED NUCLEAR FEED PUMP. Bush, A. R.; Valentin, J. E. C. (Worthington Corp., Harrison, NJ). Proc. Inst. Mech. Eng. (London); 184: No. 3N, 70-79(1969).

From Advanced-Class Boiler Feed Pumps Conference; London, United Kingdom of Great Britain and Northern Ireland (UK) (15 Sep 1970).

See CONF-700984-.

Feed pumps applied to early large-size light water moderated nuclear reactors in the United States were modifications of existing split-casing volute type pipeline pumps or multi-stage pumps. An increase in unit ratings from 500 to 800–1100 MW showed the inadequacy of these pumps for the high flows required. Accordingly, a study was undertaken to arrive at a suitable design. Various concepts were considered: number of stages, casing configuration, materials, etc. Reliability was the key consideration, along with flexibility of application and ease of manufacture. The final selection was a single-stage solid casing with an integral diffuser and condensate injection seals. The manufacturing problems which developed are discussed, together with performance tests run on the first machines of this type. (auth)

Operation and Economics

21651 (DOCKET-1151-62) ELK RIVER REACTOR. STATUS OF THE DEACTIVATED REACTOR, NOVEMBER 1, 1972—FEBRUARY 1, 1973. (United Power Association, Elk River, Minn. (USA)). 19 Feb 1973. 15p. Dep. NTIS.

21652 (DOCKET-50010-132) DRESDEN NUCLEAR POWER STATION, UNIT 1. Primary Steam Isolation Valve Failed to Close. (Commonwealth Edison Co., Chicago, Ill.). 14 Feb 1973. 2p. Dep. NTIS.

21653 (DOCKET-50010–134) DRESDEN NUCLEAR POWER STATION, UNIT 1. Emergency condenser shell side water temperature exceeded maximum specified limit. (Commonwealth Edison Co., Chicago, Ill). 23 Feb 1973. 2p. Dep. NTIS.

21654 (DOCKET-50010–135) DRESDEN NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Semiannual Report, Sections I, II, III, and IV. (Commonwealth Edison Co., Chicago, Ill.). 28 Feb 1973. 251p. (Docket 50237–299; Docket-50249–190). Dep. NTIS.

21655 (DOCKET-50016-181) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Technical Specifications, Additional Information on Change Requests. (Power Reactor Development Co., Detroit, Mich.). 20 Feb 1973. 3p. Dep. NTIS.

Additional information is presented concerning safety rod bellows, containment filters, sodium radioactivity monitoring, operating staff requirements, and emergency power capabilities. (DCC)

21656 (DOCKET-50133-108) HUMBOLDT BAY POWER PLANT, UNIT 3. Unplanned Release of Radioactive Liquid Effluent. (Directorate of Regulatory Operations (AEC), Berkeley, Calif. (USA). Region V). 7 Feb 1973. 2p. Dep. NTIS.

21657 (DOCKET-50133–109) HUMBOLDT BAY POWER PLANT, UNIT 3. Technical Specifications, Change 43. (Directorate of Licensing (AEC), Washington, D. C.). 13 Feb 1973. 2p. Dep. NTIS.

Revised technical specifications are presented concerning temperature and pressure limitations for hydrostatic tests of the primary cooling system. (DCC)

21658 (DOCKET-50206-183) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Semiannual Operating Report No. 11, July 1–December 31, 1972. (Southern California Edison Co., Rosemead, Calif.). 15 Feb 1973. 11p. Dep. NTIS.

21659 (DOCKET-50206-184) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Technical Specifications, Proposed Changes Nos. 14 and 15. (Southern California Edison Co., Rosemead, Calif.). 16 Feb 1973. 13p. Dep. NTIS.

Revised technical specifications are presented concerning burnup limits for Cycle 3 fuel elements and testing requirements for reactor instrumentation. (DCC)

21660 (DOCKET-50213-179) HADDAM NECK PLANT, UNIT 1. Operational Environmental Radiation Monitoring Program, July 1–December 31, 1972. (Interex Corp., Waltham, Mass. (USA)). 23 Feb 1973. 30p. Dep. NTIS.

For Connecticut Yankee Atomic Power Co., Haddam, CT.

21661 (DOCKET-50219-235) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Failure of Stack Gas Monitoring System. (Jersey Central Power and Light Co., Morristown, N. J.). 27 Feb 1973. 2p. Dep. NTIS.

21662 (DOCKET-50219–236) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Personnel Radiation Overexposure on January 1, 1973. (Jersey Central Power and Light Co., Morristown, N. J.). 8 Feb 1973. 4p. Dep. NTIS.

21663 (DOCKET-50237–298) DRESDEN NUCLEAR POWER STATION, UNIT 2. Setpoint of a Reactor Low Pressure Permissive Switch Out of Calibration, January 13, 1973; Setpoint of a Condenser Low Vacuum Scram Switch Out of Calibration, January 23, 1973. (Commonwealth Edison Co., Chicago, Ill.). 31 Jan 1973. 4p. Dep. NTIS.

21664 (DOCKET-50244-140) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Monthly Report of Activity Measurements, January 1, 1973–January 31, 1973. (Rochester Gas and Electric Corp., N. Y.). 8 Feb 1973. 2p. Dep. NTIS.

21665 (DOCKET-50244–141) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Release of Radioactive Gas, June 12, 1972. (Rochester Gas and Electric Corp., N. Y.). 9 Feb 1973. 2p. Dep. NTIS.

21666 (DOCKET-50245-186) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Control Rod Drive Accumulator Report. (Millstone Point Co., Hartford, Conn.). Jan 1973. 2p. Dep. NTIS.

21667 (DOCKET-50245-188) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Chloride Intrusion Incident (AO-72-22), Appendix H. (Millstone Point Co., Hartford, Conn.). 9 Feb 1973. 47p. Dep. NTIS.

21668 (DOCKET-50245-189) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Technical Specifications, Change 10. (Directorate of Licensing (AEC), Washington, D. C.). 7 Feb 1973. 2p. Dep. NTIS.
Revised technical specifications are presented concerning surveillance requirements for the station batteries. (DCC)

21669 (DOCKET-50245-190) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Technical specifications, proposed change. (Millstone Point Co., Hartford, Conn). 14 Feb 1973. 3p. Dep. NTIS.
Revised technical specifications are presented concerning surveillance testing requirements for the gas turbine generator. (DCC)

21670 (DOCKET-50245-191) MILLSTONE NUCLEAR POWER STATION, UNIT 1. General Electric Supplied Control Blades. (Millstone Point Co., Hartford, Conn.). 20 Feb 1973. 2p. Dep. NTIS.

21671 (DOCKET-50245-192) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Environmental Radiation Survey Program, July 1-December 31, 1972. (Interex Corp., Waltham, Mass. (USA)). 23 Feb 1973. 45p. Dep. NTIS.

21672 (DOCKET-50245-193) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Radiation Overexposure. (Millstone Point Co., Hartford, Conn.). 8 Feb 1973. 3p. Dep. NTIS.

21673 (DOCKET-50245-194) MILLSTONE NUCLEAR POWER STATION, Unit 1. Operational Report No. 7, July 1-December 31, 1972. (Millstone Point Co., Hartford, Conn.). 12 Feb 1973. 96p. Dep. NTIS.

21674 (DOCKET-50247-91) INDIAN POINT NUCLEAR GENERATING UNIT 2. Technical specifications, request for changes. (Consolidated Edison Co. of New York, Inc., New York). 9 Feb 1973. 7p. Dep. NTIS.
Revised technical specifications are presented concerning the refueling requirements for pressurized fuel rods. (DCC)

21675 (DOCKET-50247-94) INDIAN POINT NUCLEAR GENERATING UNIT 2. Change in Heat Tracing Control Setting. (Consolidated Edison Co. of New York, Inc., New York). 21 Feb 1973. 2p. Dep. NTIS.

21676 (DOCKET-50254-163) QUAD-CITIES STATION, UNIT 1. High Frequency Vibration. (Commonwealth Edison Co., Cordova, Ill.). 16 Feb 1973. 2p. Dep. NTIS.

21677 (DOCKET-50254-164) QUAD-CITIES STATION, UNITS 1 AND 2. Failure of Limit Switch on Main Steam Isolation Valve. (Commonwealth Edison Co., Cordova, Ill.). 16 Feb 1973. 3p. Dep. NTIS.

21678 (DOCKET-50254-165) QUAD-CITIES STATION, UNITS 1 AND 2. Excessive Chlorine Residual Concentrations in Discharge Bay. (Commonwealth Edison Co., Cordova, Ill.). 9 Feb 1973. 5p. (Docket-50265-155). Dep. NTIS.

21679 (DOCKET-50255-137) PALISADES PLANT. Semiannual Operations Report No. 4, July 1-December 31, 1972. (Consumers Power Co., Jackson, Mich.). 1 Mar 1973. 211p. Dep. NTIS.

21680 (DOCKET-50261-142) H. B. ROBINSON UNIT 2. Technical Specification, Proposed Change in Refueling Operations. (Carolina Power and Light Co., Raleigh, N. C.). 9 Feb 1973. 6p. Dep. NTIS.

21681 (DOCKET-50261-143) H. B. ROBINSON UNIT 2. Leak in Feedwater System. (Carolina Power and Light Co., Raleigh, N. C.). 9 Feb 1973. 4p. Dep. NTIS.

21682 (DOCKET-50261-144) H. B. ROBINSON UNIT 2. Technical Specifications, Change 12. (Directorate of Licensing (AEC), Washington, D. C.). 16 Feb 1973. 7p. Dep. NTIS.
Revised technical specifications are presented concerning the operating personnel and the calibration schedule for instrumentation. (DCC)

21683 (DOCKET-50261-145) H. B. ROBINSON UNIT 2. Monthly Report of Primary and Secondary Activity Measurements and Effluent Discharge Activity Levels. (Carolina Power and Light Co., Raleigh, N. C.). 16 Feb 1973. 2p. Dep. NTIS.

21684 (DOCKET-50261-146) H. B. ROBINSON UNIT 2. Steam Generator Tube Leakage Investigation. (Carolina Power and Light Co., Raleigh, N. C.). 16 Feb 1973. 63p. Dep. NTIS.

21685 (DOCKET-50263-182) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Failure of No. 1 Starting System of No. 12 Diesel Generator. (Northern States Power Co., Minneapolis, Minn.). 7 Feb 1973. 1p. Dep. NTIS.

21686 (DOCKET-50263-183) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Technical Specification Change Request Dated January 31, 1973, Supplementary Information. (Northern States Power Co., Minneapolis, Minn.). 20 Feb 1973. 2p. Dep. NTIS.
Additional data is presented concerning revised preventive maintenance procedures for the control rod drives. (DCC)

21687 (DOCKET-50263-184) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Provisional operating license DPR-22, Amendment 2. (Directorate of Licensing (AEC), Washington, D.C). 20 Feb 1973. 4p. Dep. NTIS.
Revised specifications are presented concerning the use of uranium-235 in fission chambers. (DCC)

21688 (DOCKET-50263-186) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Technical Specification Change Request Dated January 31, 1973, Additional Information. (Northern States Power Co., Minneapolis, Minn.). 20 Feb 1973. 2p. Dep. NTIS.
Revised technical specifications are presented concerning control rod drive maintenance procedures. (DCC)

21689 (DOCKET-50263-188) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Failure of No. 1 TIP Ball Valve to Isolate. (Northern States Power Co., Minneapolis, Minn.). 23 Feb 1973. 1p. Dep. NTIS.

21690 (DOCKET-50265-153) QUAD-CITIES STATION, UNIT 2. Pump Discharge Check Valve Leaking. (Commonwealth Edison Co., Cordova, Ill.). 6 Feb 1973. 3p. Dep. NTIS.

21691 (DOCKET-50265-156) QUAD-CITIES STATION, UNIT 2. Failure of an Automatic Relief Valve. (Commonwealth Edison Co., Cordova, Ill.). 9 Feb 1973. 3p. Dep. NTIS.

21692 (DOCKET-50266-101) POINT BEACH NUCLEAR PLANT, UNIT 1. Steam Generator Tube Defects. (Wisconsin Electric Power Co., Milwaukee). 20 Feb 1973. 4p. Dep. NTIS.

21693 (DOCKET-50267-54) FORT ST. VRAIN NUCLEAR GENERATING STATION. Control and orificing assemblies, repair work. (Public Service Co. of Colorado, Denver). 15 Feb 1973. 6p. Dep. NTIS.

21694 (DOCKET-50271-135) VERMONT YANKEE NUCLEAR POWER STATION. Failure of Containment Air Monitoring System on December 22, 1972; Startup Transformer Failed on December 27, 1972; Three IRM Channels Inoperable on Startup, January 9, 1973 (Blown Fuses). (Vermont Yankee Nuclear Power Corp., Rutland). 15 Jan 1973. 9p. Dep. NTIS.

21695 (DOCKET-50271-141) VERMONT YANKEE NUCLEAR POWER STATION. Proposed Change 2, Supplementary Information. (Vermont Yankee Nuclear Power Corp., Rutland). 12 Feb 1973. 5p. Dep. NTIS.
Revised technical specifications are presented concerning the activation conditions for the main steam isolation valves. (DCC)

21696 (DOCKET-50271-142) VERMONT YANKEE NUCLEAR POWER STATION. Transformer Failure, December 27, 1972. (Vermont Yankee Nuclear Power Corp., Rutland). 12 Feb 1973. 23p. Dep. NTIS.

21697 (DOCKET-50271-145) VERMONT YANKEE NUCLEAR POWER STATION. Notice of Issuance of Amendment to Facility Operating License. (Directorate of Licensing (AEC), Washington, D. C.). 26 Feb 1973. 13p. Dep. NTIS.

21698 (DOCKET-50280-105) SURRY POWER STATION, UNIT 1. Defective Check Valve, November 22, 1972. (Virginia Electric and Power Co., Richmond). 26 Jan 1973. 12p. Dep. NTIS.

21699 (DOCKET-50280-106) SURRY POWER STATION, UNIT 1. AO-S1-72-04, Calibration Shift in All Barton Transmitters on July 16, 1972. (Virginia Electric and Power Co., Richmond). 6 Feb 1973. 7p. Dep. NTIS.

21700 (DOCKET-50280-110) SURRY POWER STATION, UNIT 1. Action Taken to Correct a Violation of AEC Requirements Brought to Attention Following Inspection of September 18-21, 1972. (Virginia Electric and Power Co., Richmond). 6 Feb 1973. 5p. Dep. NTIS.

Information is presented concerning access to the containment structure for specified radiation levels. (DCC)

21701 (DOCKET-50281-89) SURRY POWER STATION, UNIT 2. AO-52-73-01, inadvertent release of low level of radioactivity to containment atmosphere. (Virginia Electric and Power Co., Richmond). 2 Mar 1973. 10p. Dep. NTIS.

21702 (DOCKET-50285-83) FORT CALHOUN STATION, UNIT 1. Fuel densification effects. (Omaha Public Power District, Nebr). 4 Jan 1973. 8p. Dep. NTIS.

21703 (DOCKET-50293-115) PILGRIM NUCLEAR POWER STATION. Main steam relief valve out of calibration, December 31, 1972. Barksdale pressure switches out of calibration January 7, 1973. (Boston Edison Co., Mass). 8 Jan 1973. 5p. Dep. NTIS.

21704 (DOCKET-50293-117) PILGRIM NUCLEAR POWER STATION. Barksdale Pressure Switches Out of Calibration, January 10, 1973. Barksdale Pressure Switches and Barton Differential Pressure Indicating Switches Out of Calibration January 14, 1973. (Boston Edison Co., Mass). 24 Jan 1973. 6p. Dep. NTIS.

21705 (DOCKET-50293-118) PILGRIM NUCLEAR POWER STATION. Barton Differential Pressure Indicating Switches Out of Calibration January 1973. HPCI High Flow Switches Out of Calibration December 8, 1972. (Boston Edison Co., Mass.). 19 Jan 1973. 3p. Dep. NTIS.

21706 (DOCKET-50293-119) PILGRIM NUCLEAR POWER STATION. Semiannual Report No. 1, June 8-December 31, 1972. (Boston Edison Co., Mass.). 8 Feb 1973. 112p. Dep. NTIS.

21707 (DOCKET-50293-121) PILIGRIM NUCLEAR POWER STATION. Two Main Steam Line Isolation Valves Out of Calibration. (Boston Edison Co., Mass.). 28 Feb 1973. 1p. Dep. NTIS.

21708 (DOCKET-50295-86) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Diesel Generator Cause/Failure Analysis. (Commonwealth Edison Co., Chicago, Ill.). 8 Feb 1973. 4p. Dep. NTIS.

21709 (DOCKET-50301-83) POINT BEACH NUCLEAR PLANT, UNIT 2. Fuel densification and its effects, additional testimony. (Directorate of Licensing (AEC), Washington, D.C). 2 Feb 1973. 77p. Dep. NTIS.

21710 (DOCKET-50309-89) MAINE YANKEE ATOMIC POWER STATION. Control element assemblies misfunction on January 6, 1973. (Maine Yankee Atomic Power Co., Wiscasset). 27 Jan 1973. 2p. Dep. NTIS.

21711 (DOCKET-50309-90) MAINE YANKEE ATOMIC POWER STATION. MONTHLY REPORT 12-72, DECEMBER 1972. (Maine Yankee Atomic Power Co., Westboro, Mass). Feb 1973. 26p. Dep. NTIS.

21712 (DOCKET-50334-52) BEAVER VALLEY POWER STATION, UNIT 1. Fire at Motor Control Center. (Duquesne Light Co., Pittsburgh, PA). 21 Dec 1972. 4p. Dep. NTIS.

21713 (DOCKET-50409-36) LA CROSSE BOILING WATER REACTOR. Incident report 72-7, hydrogen detonation in main condenser off-gas system July 10, 1972. (Dairyland Power Cooperative, La Crosse, Wis). 1 Feb 1973. 4p. Dep. NTIS.

21714 (DOCKET-50409-37) LA CROSSE BOILING WATER REACTOR. Monthly Operating Report for November 1972. (Dairyland Power Cooperative, La Crosse, Wis.). Nov 1972. Contract AT(11-1)-851. 31p. (DPC-851-50). Dep. NTIS.

21715 (EUR-4917) 50 MWe DODEWAARD NUCLEAR POWER PLANT, ANNUAL REPORT 1971. (Gemeenschappelijke Kernenergiecentrale Nederland N. V., Dodewaard). Feb 1973. 130p. (In Dutch). Dep. NTIS (U. S. Sales Only). EURB.Fr.175,-.

A summary is presented of the most important events during the first three years of operation, which are regarded as the running-in phase for the plant. Plant availability during this period was 76.4%. During the year, only one important fault occurred, namely, the failure of several bolts attaching the control-rod drive mechanism to the nozzles beneath the pressure vessel. The principal cause of the fracture was hydrogen embrittlement. A matter for concern was the radiation dose received by the personnel, and steps to reduce this have been taken. A detailed survey of plant management, reactor physics, maintenance and chemical and radiation-chemical aspects is provided. (auth)

21716 (EUR-4925) OBRIGHEIM NUCLEAR POWER PLANT, ANNUAL REPORT 1971. (Kernkraftwerk Lingen G.M.B.H. (West Germany)). Feb 1973. 72p. (In German). Dep. NTIS (U. S. Sales Only). EURFB 100.-.

During 1971 the Obrigheim nuclear power plant ran at base load. About 2.26×10^9 kWh were produced. The plant was in operation for 6,735 h and thus achieved a time/availability factor of 76.9%. Of the 23.1% non-availability, 13% was due to the second refuelling and to the work carried out during this shut-down. Inspection of the fuel elements revealed that those due to be recharged in the reactor were completely undamaged, while there were two faults in those scheduled for final unloading, since they had reached their target burnup. During 1971 a total of 14 heat exchanger tubes in steam generator 2 were sealed by explosion welding. Of these, seven were faulty and seven were intact tubes in their immediate vicinity. The activity transmitted to the air and water was well below the permitted levels. (auth)

21717 (EUR-4926) LINGEN NUCLEAR POWER PLANT. Annual Report, 1971. (Kernkraftwerk Lingen G.M.B.H. (West Germany)). Feb 1973. 56p. (In German). Dep. NTIS (U. S. Sales Only). EUR FB 70,-.

During 1971 a total of 1,362,000,000 kWh were fed into the grid of the Vereinigte Elektrizitätswerke Westfalen AG. The availability of the plant was 65.9% and the utilization factor 62.4%. The low availability stems from the long period of shutdown during 1 May to 26 August 1971, when in particular the turbine damage was repaired. The turbine inspection in the summer of 1970 revealed that several LP 2 blades had fractured. Since the manufacture of new blades took quite a long time, all of the blades in the affected rows were trued up. The repairs, i.e., the replacement of the defective blades by new strengthened blades, were carried out in the summer of 1971. On conclusion of the work aimed at raising the output of the turboset, the net output of the plant was increased by 16 MW to 256 MW net. This increase in output is mainly due to the injection of make-up water into the superheater. The secondary steam superheater was converted from heavy heating oil to natural gas. The operation of the plant has been logged in detail. The section on in-service monitoring provides data on radiation protection and on plant chemistry and physics. (auth)

21718 (GA-10502) 40-MW(e) PROTOTYPE HIGH-TEMPERATURE GAS-COOLED REACTOR POSTCONSTRUCTION RESEARCH AND DEVELOPMENT PROGRAM. Quarterly Progress Report for the Period Ending January 31, 1971. (Gulf General Atomic Co., San Diego, Calif.). 26 Feb 1971. Contract AT(04-3)-314. 16p. Dep. NTIS.

PEACH BOTTOM POWER REACTOR, UNIT 1
—operations during July 1970 to January 1971
—fuel elements for, distribution of fission products in
—cooling system for, performance of helium purification system for

21719 MODEL FOR THE STRATEGIC OPERATIONAL PLANNING OF POWER SYSTEMS CONTAINING LARGE AMOUNTS OF NUCLEAR CAPACITY. Rhodes, J. T. Lafayette, IN; Purdue Univ. (1972). 215p. University Microfilms Order No. 72-30,965. Thesis.

Nuclear generating units are becoming the prime source of electrical energy in some utility power systems. A model that can be used to plan the multi-year strategic operation of multi-nuclear unit systems is discussed. Using the Burlington PWR as a reference core design, an example set of the discounted fuel cost and criticality constraint functions was determined. It was found that the resulting burnup and cost data could be linearly correlated to within an accuracy of about two percent, thereby

allowing the discounted fuel cost and criticality constraint functions to be represented as linear relationships. This in turn allowed linear programming to be used as an optimization technique in the model. As an illustration of the application of the model to strategic operational planning, a hypothetical reference power system containing one "lumped" fossil unit and three Burlington-type nuclear units was then examined. It was found that: (1) The loading pattern that gave the minimum system fuel cost for a given refueling schedule could be rapidly determined using linear programming. (2) In strategic operation, refueling schedules that allow the displacement of as much conventional unit generated energy with nuclear unit generated energy as possible is much more important than achieving full nuclear energy utilization in any one refueling cycle; system energy cost savings on the order of 0.1 mills/kwhr are involved in the former as opposed to 0.01 mills/kwhr in the latter. (3) An extended forced outage (of the order of months) of a nuclear unit can result in substantial cost penalty, on the order of 0.05 mills/kwhr, and major rescheduling of the refueling shutdowns of several nuclear units as well as derated extensions of some refueling cycles may be necessary to minimize this penalty. (4) A planning period length of three to four years appears to be adequate for strategic planning purposes. It should be emphasized that these findings strictly apply only to the reference power system; however, they should apply in principle to most multi-nuclear systems. In any case, it can be concluded that a significant savings in costs and effort can be achieved by using the model, or an extension of it, for strategic operational planning purposes. (Diss. Abstr. Int., B)

21720 CONSIDERATIONS EMERGING FROM FUEL MANAGEMENT EXPERIENCE WITH ENEL'S REACTORS. Belelli, U.; Cometto, M. Energ. Nucl. (Milan); 19: No. 12, 744-9 (Dec 1972).

The fuel behavior in ENEL's nuclear power stations, Garigliano, Trino Vercellese and Latina is briefly reviewed. The operation of these stations has allowed ENEL to acquire a noticeable experience on the various aspects of the fuel cycle, thus determining the evolution of the basic criteria of fuel management. A few meaningful examples of this evolution and the economic and contractual implications resulting from the assumption by the utility of wider responsibilities in core management are discussed. In connection with the destination of the fissile materials recovered from reprocessing, the technical basis and the economic considerations which led ENEL to start recycling plutonium in its reactors in 1974 are illustrated. (auth)

21721 DEVELOPMENT OF THE COMMERCIAL BREEDERS. Barnard, J.; Fidrych, L. F.; Gibson, A. S.; (and others) (General Electric Co., Sunnyvale, CA). Nucl. News; 15: No. 12, 30-6(Dec 1972).

The major incentives for the development of the commercial sodium-cooled fast breeder reactor are discussed and include conservation of fuel resources, reduced ecological effects, and improved economics. The chronology of past LMFBR development in the US and Europe and the scheduling of plants either under construction or planned for operation by 1980 are described. Based on steps taken to achieve commercial success with water reactors, possible alternative routes to commercial LMFBR power are compared as to overall time scheduling and overall cost. It is concluded that to achieve commercially competitive LMFBR's in the US steps should be taken to complete and start up the demonstration plant (or plants) and to design, develop, construct, and operate large technologically advanced power plants that can be sold in multiple units. (LCL)

Safety and Siting

Refer also to abstracts 19815, 19824, and 20169.

21722 (DOCKET-50003-154) INDIAN POINT STATION, UNIT 1. Limitorque Valve Operators. (Consolidated Edison Co. of New York, Inc., New York). 29 Dec 1972. 1p. Dep. NTIS.

21723 (DOCKET-50003-156) INDIAN POINT STATION, UNIT 1. Control Circuits of Safety Related Equipment. (Consolidated Edison Co. of New York, Inc., New York). 20 Feb 1973. 12p. Dep. NTIS.

21724 (DOCKET-50010-133) DRESDEN NUCLEAR POWER STATION, UNIT 1. Fuel Densification Effects. (Commonwealth Edison Co., Chicago, Ill). 27 Feb 1973. 7p. Dep. NTIS.

21725 (DOCKET-50029-223) YANKEE NUCLEAR POWER STATION. Limitorque Valve Operators. (Yankee Atomic Electric Co., Westboro, Mass.). 13 Dec 1972. 4p. Dep. NTIS.

21726 (DOCKET-50029-225) YANKEE NUCLEAR POWER STATION, CONTROL CIRCUITS FOR SAFETY RELATED EQUIPMENT. (Yankee Atomic Electric Co., Westboro, Mass.). 13 Feb 1973. 1p. Dep. NTIS.

21727 (DOCKET-50029-226) YANKEE NUCLEAR POWER STATION. Fuel Densification Effects. (Yankee Atomic Electric Co., Westboro, Mass.). 16 Feb 1973. 53p. Dep. NTIS.

21728 (DOCKET-50133-110) HUMBOLDT BAY POWER PLANT, UNIT 3. Control Circuits of Safety Related Equipment. (Pacific Gas and Electric Co., San Francisco, Calif.). 20 Feb 1973. 3p. Dep. NTIS.

21729 (DOCKET-50171-112) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Limitorque Valve Operators. (Philadelphia Electric Co., PA). 20 Dec 1972. 3p. Dep. NTIS.

21730 (DOCKET-50171-113) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Control Circuits of Safety Related Equipment. (Philadelphia Electric Co., PA). 15 Feb 1973. 1p. Dep. NTIS.

21731 (DOCKET-50206-182) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. ECCS Performance Analyses. (Southern California Edison Co., Rosemead, Calif.). 31 Jan 1973. 56p. Dep. NTIS.

21732 (DOCKET-50206-186) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Control Circuits for Circuit Breakers of Safety Related Equipment. (Southern California Edison Co., Rosemead, Calif.). 22 Feb 1973. 1p. Dep. NTIS.

21733 (DOCKET-50213-176) HADDAM NECK PLANT, UNIT 1. Environmental Report, Addenda 4, Appendix B. (Connecticut Yankee Atomic Power Co., Hartford). Feb 1973. 68p. Dep. NTIS.

21734 (DOCKET-50213-177) HADDAM NECK PLANT, UNIT 1. Environmental Report, Addenda 5. (Connecticut Yankee Atomic Power Co., Hartford). 15 Feb 1973. 99p. Dep. NTIS.

21735 (DOCKET-50213-178) HADDAM NECK PLANT, UNIT 1. Review of Control Circuits of Safety Related Equipment. (Connecticut Yankee Atomic Power Co., Hartford). 22 Feb 1973. 2p. Dep. NTIS.

21736 (DOCKET-50219-234) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Facility Change Request 4, Supplement 1. (Jersey Central Power and Light Co., Morristown, N. J.). 22 Feb 1973. 32p. Dep. NTIS.

Additional information is presented concerning physics measurements for Type 3B fuel assemblies and safety analysis of control rod drop and withdrawal accidents. (DCC)

21737 (DOCKET-50220-124) NINE MILE POINT NUCLEAR STATION, UNIT 1. Control Circuit Design of All Safety Related Equipment. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 2 Feb 1973. 2p. Dep. NTIS.

21738 (DOCKET-50244-139) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Environmental Report, Supplement 1. (Rochester Gas and Electric Corp., N.Y.). Feb 1973. 46p. Dep. NTIS.

21739 (DOCKET-50244-144) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Review of Control Circuits Design and Procedures. (Rochester Gas and Electric Corp., N. Y.). 26 Feb 1973. 1p. Dep. NTIS.

21740 (DOCKET-50245-195) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Review of Control Circuits of Safety Related Equipment. (Millstone Point Co., Hartford, Conn.). 22 Feb 1973. 1p. Dep. NTIS.

21741 (DOCKET-50247-93) INDIAN POINT NUCLEAR GENERATING UNIT 2. Order Extending Completion Date to June 1, 1973. (Directorate of Licensing (AEC), Washington, D.C.). 20 Feb 1973. 3p. Dep. NTIS.

21742 (DOCKET-50247-95) INDIAN POINT NUCLEAR GENERATING UNIT 2. Order Extending Facility Operating License Expiration Date to June 1, 1973. (Directorate of Licensing (AEC), Washington, D. C.). 1 Mar 1973. 4p. Dep. NTIS.

21743 (DOCKET-50247-96) INDIAN POINT NUCLEAR GENERATING UNIT 2. Limitorque Valve Operators. (Con-

solidated Edison Co. of New York, Inc., New York). 21 Feb 1973. 5p. Dep. NTIS.

21744 (DOCKET-50254-162) QUAD-CITIES STATION, UNITS 1 AND 2. La Salle County Station, Units 1 and 2. Limitorque Valve Operators. (Commonwealth Edison Co., Chicago, Ill.). 16 Feb 1973. 5p. (Docket 50265-154; Docket-50373-33; Docket-50374-32). Dep. NTIS.

21745 (DOCKET-50255-133) PALISADES PLANT. Technical Specifications, Additional Loss of Coolant Accident Calculations. (Consumers Power Co., Jackson, Mich.). 12 Feb 1973. 2p. Dep. NTIS.

21746 (DOCKET-50255-134) PALISADES PLANT. Technical Specifications, Change 3. (Directorate of Licensing (AEC), Washington, D.C.). 16 Feb 1973. 4p. Dep. NTIS.
Revised technical specifications are presented concerning instrumentation requirements for reactor startup. (DCC)

21747 (DOCKET-50259-77) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Action taken regarding electrical separation. (Tennessee Valley Authority, Chattanooga). 13 Feb 1973. 14p. Dep. NTIS.

21748 (DOCKET-50261-147) H. B. ROBINSON UNIT 2. Request for Revision of Technical Specifications, Control Rod Insertion Limits. (Carolina Power and Light Co., Raleigh, N. C.). 22 Feb 1973. 2p. Dep. NTIS.

21749 (DOCKET-50263-120) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Environmental report, Supplement 1. (Division of Reactor Licensing (AEC), Washington, D.C). 4 Apr 1972. 118p. Dep. NTIS.

21750 (DOCKET-50263-180) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Safety Evaluation for Full-Term License Review. (Directorate of Licensing (AEC), Washington, D. C.). 5 Feb 1973. 165p. Dep. NTIS.

21751 (DOCKET-50263-181) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Supplemental report of a change in transient analysis as described in the FSAR. (Northern States Power Co., Minneapolis, Minn). 13 Feb 1973. 16p. Dep. NTIS.
Revised information is presented concerning end-of-cycle transient analysis. (DCC)

21752 (DOCKET-50263-185) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Control Circuits of Safety Related Equipment. (Northern States Power Co., Minneapolis, Minn.). 20 Feb 1973. 3p. Dep. NTIS.

21753 (DOCKET-50263-187) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Request for Authorization to Operate with Reload Fuel in The Core. (Northern States Power Co., Minneapolis, Minn.). 20 Feb 1973. 42p. Dep. NTIS.

21754 (DOCKET-50266-99) POINT BEACH NUCLEAR PLANT, UNIT 1. Limitorque Valve Operators. (Wisconsin Electric Power Co., Milwaukee). 18 Jan 1973. 6p. (DOCKET-50301-84). Dep. NTIS.

21755 (DOCKET-50266-100) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. Emergency Operating Organization. (Wisconsin Electric Power Co., Milwaukee). 19 Feb 1973. 3p. (DOCKET-50301-85). Dep. NTIS.

21756 (DOCKET-50266-102) POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2. FLOODING RESULTING FROM NON-CATEGORY I FAILURE. (Wisconsin Electric Power Co., Milwaukee). 20 Feb 1973. 4p. (DOCKET-50301-86). Dep. NTIS.

21757 (DOCKET-50267-53) FORT ST. VRAIN NUCLEAR GENERATING STATION. Valve Wall Thickness, Nuclear Safety Related Valves. (Public Service Co. of Colorado, Denver). 29 Dec 1972. 13p. Dep. NTIS.

21758 (DOCKET-50269-92) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Fuel Densification Effects. (Duke Power Co., Charlotte, N. C.). 12 Jan 1973. 1p. (DOCKET-50270-73; DOCKET-50287-66). Dep. NTIS.

21759 (DOCKET-50269-94) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Minimum Wall Thickness of Valves Important to Nuclear Safety. (Duke Power Co., Charlotte, N. C.). 7 Mar 1973. 10p. (DOCKET-50270-76; 50287-68. Dep. NTIS.

21760 (DOCKET-50270-74) OCONEE NUCLEAR STATION, UNIT 2. ORDER EXTENDING COMPLETION DATE TO SEPTEMBER 1, 1973. (Directorate of Licensing (AEC), Washington, D. C.). 28 Feb 1973. 3p. Dep. NTIS.

21761 (DOCKET-50271-139) VERMONT YANKEE NUCLEAR POWER STATION. Limitorque Valve Operators. (Vermont Yankee Nuclear Power Corp., Rutland). 28 Dec 1972. 5p. Dep. NTIS.

21762 (DOCKET-50271-140) VERMONT YANKEE NUCLEAR POWER STATION. Valve wall thickness. (Vermont Yankee Nuclear Power Corp., Rutland). 9 Jan 1973. 2p. Dep. NTIS.

21763 (DOCKET-50272-48) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Limitorque Valve Operators. (Public Service Electric and Gas Co., Newark, N.J.). 21 Dec 1972. 4p. (DOCKET-50311-49). Dep. NTIS.

21764 (DOCKET-50280-107) SURRY POWER STATION, UNITS 1 AND 2. Proposed Technical Specifications Change 30, Request Deletion. (Virginia Electric and Power Co., Richmond). 7 Feb 1973. 2p. (DOCKET-50281-86). Dep. NTIS.
Revised technical specifications are presented concerning the installation date for the underwater electric cable for the temperature and salinity monitoring system. (DCC)

21765 (DOCKET-50280-109) SURRY POWER STATION, UNIT 1. Fuel Densification Effects, Resolution of Differences in Surry 1 and Point Beach 2 Calibrations. (Virginia Electric and Power Co., Richmond). 20 Feb 1973. 5p. Dep. NTIS.

21766 (DOCKET-50281-87) SURRY POWER STATION, UNIT 2. Indemnity Agreement B-45, Amendment 5. (Virginia Electric and Power Co., Richmond). 30 Jan 1973. 3p. Dep. NTIS.
Revised information is presented concerning chemical and thermal effluents from the reactor. (DCC)

21767 (DOCKET-50282-92) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Draft environmental statement. (Directorate of Licensing (AEC), Washington, D.C). Jan 1973. 294p. (DOCKET-50306-87). Dep. NTIS.
The environmental effects of construction and operation of the Prairie Island Power Reactor, Units 1 and 2 are examined. The descriptions include: (1) the environment in the area, including the history, geography and geology, hydrology, climatology, ecology, land and water use including chemical characteristics, (2) the facility and its effluents, (3) the impacts from construction and operation of the unit, (4) alternatives to the proposed action, (5) irreversible and irretrievable long-term commitments of resources from plant operation, (6) need for power, and (7) the benefits-cost analysis of the proposed plant operation. (JWR)

21768 (DOCKET-50285-84) FORT CALHOUN STATION, UNIT 1. Fuel Densification Effects. (Omaha Public Power District, Nebr.). 5 Feb 1973. 6p. Dep. NTIS.

21769 (DOCKET-50286-65) INDIAN POINT NUCLEAR GENERATING UNIT 3. Application for licenses, Amendment 27. (Consolidated Edison Co. of New York, Inc., New York). 20 Feb 1973. 7p. Dep. NTIS.

21770 (DOCKET-50289-88) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Limitorque Valve Operators. (Metropolitan Edison Co., Reading, PA). 1 Dec 1972. 5p. Dep. NTIS.

21771 (DOCKET-50289-89) THREE MILE ISLAND NUCLEAR STATION, UNITS 1 AND 2. Steam Generator Weld Records. (Metropolitan Edison Co., Reading, PA). 21 Feb 1973. 24p. (DOCKET-50320-43). Dep. NTIS.

21772 (DOCKET-50289-91) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Limitorque Valve Operators, Update of Letter of January 5, 1973. (Metropolitan Edison Co., Reading, PA). 6 Mar 1973. 4p. Dep. NTIS. $3.00.

21773 (DOCKET-50293-114) PILGRIM NUCLEAR POWER STATION. Limitorque Valve Operators. (Boston Edison Co., Mass.). 1 Dec 1972. 5p. Dep. NTIS.

21774 (DOCKET-50293-120) PILGRIM NUCLEAR POWER STATION. Review of Safety Related Control Circuit Design. (Boston Edison Co., Mass.). 22 Feb 1973. 2p. Dep. NTIS.

21775 (DOCKET-50295-87) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Preoperational Containment Leak Rate Test. (Commonwealth Edison Co., Chicago, Ill.). 21 Feb 1973. 299p. Dep. NTIS.

21776 (DOCKET-50298-68) COOPER NUCLEAR STATION. Safety Evaluation. (Directorate of Licensing (AEC), Washington, D. C.). 14 Feb 1973. 222p. Dep. NTIS.

21777 (DOCKET-50298-69) COOPER NUCLEAR STATION. Final Environmental Statement. (Directorate of Licensing (AEC), Washington, D.C.). Feb 1973. 264p. Dep. NTIS.

The environmental effects of construction and operation of the Cooper Nuclear Station are examined. The descriptions include: (1) the environment in the area, including the history, geography and geology, hydrology, climatology, ecology, land and water use including chemical characteristics, (2) the facility and its effluents, (3) the impacts from construction and operation of the unit, (4) alternatives to the proposed action, (5) irreversible and irretrievable long-term commitments of resources from plant operation, (6) need for power, and (7) the benefits–cost analysis of the proposed plant operation. (JWR)

21778 (DOCKET-50302-62) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. Limitorque Valve Operators. (Florida Power Corp., St. Petersburg). 8 Mar 1973. 7p. Dep. NTIS.

21779 (DOCKET-50309-91) MAINE YANKEE ATOMIC POWER STATION. Limitorque Valve Operators. (Maine Yankee Atomic Power Co., Westboro, Mass.). 21 Dec 1972. 4p. Dep. NTIS.

21780 (DOCKET-50309-93) MAINE YANKEE ATOMIC POWER STATION. OFFSITE ENVIRONMENTAL RADIOLOGICAL MONITORING, JULY 1, 1972–DECEMBER 31, 1972. (Maine Yankee Atomic Power Co., Westboro, Mass). 1 Mar 1973. 33p. Dep. NTIS.

21781 (DOCKET-50312-61) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Limitorque Valve Operators. (Sacramento Municipal Utility District, Calif.). 15 Feb 1973. 2p. Dep. NTIS.

21782 (DOCKET-50312-63) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Inspection of Steam Generator Weld Records. (Sacramento Municipal Utility District, Calif.). 16 Feb 1973. 24p. Dep. NTIS.

21783 (DOCKET-50313-63) ARKANSAS NUCLEAR ONE, UNIT 1. Design Error in Service Water Lines. (Arkansas Power and Light Co., Pine Bluff (USA)). 26 Jan 1973. 4p. Dep. NTIS.

21784 (DOCKET-50313-64) ARKANSAS NUCLEAR ONE, UNIT 1. Final Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Feb 1973. 369p. Dep. NTIS.

The environmental effects of construction and operation of the Arkansas Nuclear One Power Reactor are examined. The descriptions include: (1) the environment in the area, including the history, geography and geology, hydrology, climatology, ecology, land and water use including chemical characteristics, (2) the facility and its effluents, (3) the impacts from construction and operation of the unit, (4) alternatives to the proposed action, (5) irreversible and irretrievable long-term commitments of resources from plant operation, (6) need for power, and (7) the benefits-cost analysis of the proposed plant operation. (JWR)

21785 (DOCKET-50315-96) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Limitorque Valve Operators, Supplement to Letter January 4, 1973. (American Electric Power Service Corp., New York). 12 Feb 1973. 5p. (DOCKET-50316-96). Dep. NTIS.

21786 (DOCKET-50315-97) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 37. (Westinghouse Electric Corp., Pittsburgh, PA). Feb 1973. 51p. (Docket-50316-97). Dep. NTIS.

For American Electric Power Service Corp., New York, NY.

Revised information is presented concerning the performance evaluation of the emergency core cooling system. (DCC)

21787 (DOCKET-50317-80) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Safety Evaluation. (Directorate of Licensing (AEC), Washington, D.C.). 28 Aug 1972. 107p. (DOCKET-50318-77). Dep. NTIS.

21788 (DOCKET-50317-82) CALVERT CLIFFS NUCLEAR POWER PLANT. Limitorque Valve Operators. (Baltimore Gas and Electric Co., MD). 28 Dec 1972. 5p. (DOCKET-50318-79). Dep. NTIS.

21789 (DOCKET-50320-42) THREE MILE ISLAND NUCLEAR STATION, UNIT 2. Limitorque Valve Operators. (Metropolitan Edison Co., Reading, Pa.). 5 Jan 1973. 5p. Dep. NTIS.

21790 (DOCKET-50322-33) SHOREHAM NUCLEAR POWER STATION, UNIT 1. Limitorque Valve Operators. (Long Island Lighting Co., Hicksville, N.Y.). 9 Jan 1973. 4p. Dep. NTIS.

21791 (DOCKET-50329-35) MIDLAND PLANT, UNITS 1 AND 2. Steam Generator Weld Records. (Consumers Power Co., Jackson, Mich.). 12 Feb 1973. 5p. (DOCKET-50330-34). Dep. NTIS.

21792 (DOCKET-50329-36) MIDLAND PLANT, UNITS 1 AND 2. Fuel Densification Effects. (Consumers Power Co., Jackson, Mich.). 28 Feb 1973. 2p. (DOCKET-50330-35). Dep. NTIS.

21793 (DOCKET-50331–85) DUANE ARNOLD ENERGY CENTER. Environmental report, Amendment 5. (Iowa Electric Light and Power Co., Cedar Rapids). 1 Mar 1973. 47p. Dep. NTIS.

21794 (DOCKET-50331–86) DUANE ARNOLD ENERGY CENTER. Safety evaluation, Supplement 1. (Directorate of Licensing (AEC), Washington, D.C). 2 Mar 1973. 12p. Dep. NTIS.

21795 (DOCKET-50331–87) DUANE ARNOLD ENERGY CENTER. Final environmental statement. (Directorate of Licensing (AEC), Washington, D.C). Mar 1973. 333p. Dep. NTIS. $18.75.

The environmental effects of construction and operation of the Duane Arnold Power Reactor are examined. The descriptions include: (1) the environment in the area, including the history, geography and geology, hydrology, climatology, ecology, land and water use including chemical characteristics, (2) the facility and its effluents, (3) the impacts from construction and operation of the unit, (4) alternatives to the proposed action, (5) irreversible and irretrievable long-term commitments of resources from plant operation, (6) need for power, and (7) the benefits-cost analysis of the proposed plan operation. (JWR)

21796 (DOCKET-50333-80) JAMES A. FITZPATRIC NUCLEAR POWER PLANT. Drywell Torus Bypass Leakage. Reactor Pressure Vessel Plates Fracture Toughness. (Power Authority of the State of New York). 2 Feb 1973. 6p. Dep. NTIS.

21797 (DOCKET-50333-81) JAMES A. FITZPATRICK NUCLEAR POWER PLANT. Limitorque Valve Operators. (Power Authority of the State of New York). 8 Jan 1973. 3p. Dep. NTIS.

21798 (DOCKET-50334-53) BEAVER VALLEY POWER STATION, UNIT 1. Limitorque Valve Operators. (Duquesne Light Co., Pittsburgh, Pa.). 2 Jan 1973. 9p. Dep. NTIS.

21799 (DOCKET-50334–55) BEAVER VALLEY POWER STATION, UNIT 1. Crack in weld preparation land area, reactor vessel nozzle. (Duquesne Light Co., Pittsburgh, PA). 8 Feb 1973. 14p. Dep. NTIS.

21800 (DOCKET-50335-43) ST. LUCIE PLANT, UNIT 1. Emergency Plan, Volume 1. (Florida Power and Light Co.). Jan 1973. 351p. Dep. NTIS.

21801 (DOCKET-50336-50) MILLSTONE NUCLEAR POWER STATION, UNIT 2. Limitorque Valve Operators. (Millstone Point Co., Hartford, Conn.). 27 Dec 1972. 4p. Dep. NTIS.

21802 (DOCKET-50335-42) ST. LUCIE PLANT, UNIT 1. Application for Operating Licenses. (Florida Power and Light Co.). 28 Feb 1973. 46p. Dep. NTIS.

21803 (DOCKET-50340-6) SEABROOK NUCLEAR STATION, UNIT 1. Limitorque Valve Operators. (Public Service Co. of New Hampshire, Manchester). 20 Dec 1972. 4p. Dep. NTIS.

21804 (DOCKET-50341-51) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Limitorque Valve Operators, Supplement of Letter Dated January 22, 1973. (Detroit Edison Co., Mich.). 8 Feb 1973. 4p. Dep. NTIS.

21805 (DOCKET-50344–47) TROJAN NUCLEAR PLANT. Notice of receipt of application for facility operating license. Notice of consideration of issuance of facility license. Notice

of opportunity for hearing. (Directorate of Licensing (AEC), Washington, D.C). 16 Feb 1973. 7p. Dep. NTIS.

21806 (DOCKET-50346-41) DAVIS-BESSE NUCLEAR POWER STATION. Final environmental statement. (Directorate of Licensing (AEC), Washington, D.C). Mar 1973. 284p. Dep. NTIS.

The environmental effects of construction and operation of the Davis-Besse Power Reactor are examined. The descriptions include: (1) the environment in the area, including the history, geography and geology, hydrology, climatology, ecology, land and water use including chemical characteristics, (2) the facility and its effluents, (3) the impacts from construction and operation of the unit, (4) alternatives to the proposed action, (5) irreversible and irretrievable long-term commitments of resources from plant operation, (6) need for power, and (7) the benefits-cost analysis of the proposed plant operation. (JWR)

21807 (DOCKET-50352-33) LIMERICK GENERATING STATION, UNITS 1 AND 2. Limitorque Valve Operators. (Philadelphia Electric Co., Pa.). 2 Jan 1973. 5p. (Docket-50353-33). Dep. NTIS.

21808 (DOCKET-50363-45) FORKED RIVER NUCLEAR GENERATING STATION, UNIT 1. Limitorque Valve Operators. (Jersey Central Power and Light Co., Morristown, N. J.). 5 Jan 1973. 4p. Dep. NTIS.

21809 (DOCKET-50363-47) FORKED RIVER NUCLEAR GENERATING STATION, UNIT 1. Final Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Feb 1973. 252 p. Dep. NTIS.

The environmental effects of construction and operation of the Forked River Nuclear Station Unit 1 are examined. The descriptions include: (1) the environment in the area, including the history, geography and geology, hydrology, climatology, ecology, land and water use including chemical characteristics, (2) the facility and its effluents, (3) the impacts from construction and operation of the unit, (4) alternatives to the proposed action, (5) irreversible and irretrievable long-term commitments of resources from plant operation, (6) need for power, and (7) the benefits-cost analysis of the proposed plant operation. (JWR)

21810 (DOCKET-50363-48) FORKED RIVER NUCLEAR GENERATING STATION, UNIT 1. Main Steam and Feedwater Lines Tunnel, Design Considerations. (Jersey Central Power and Light Co., Morristown, N. J.). 21 Feb 1973. 5p. Dep. NTIS.

21811 (DOCKET-50367-34) BAILLY GENERATING STATION, NUCLEAR I. Final Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Feb 1973. 336 p. Dep. NTIS.

The environmental effects of construction and operation of the Bailly Power Reactor, Unit 1 are examined. The descriptions include: (1) the environment in the area, including the history, geography and geology, hydrology, climatology, ecology, land and water use including chemical characteristics, (2) the facility and its effluents, (3) the impacts from construction and operation of the unit, (4) alternatives to the proposed action, (5) irreversible and irretrievable long-term commitments of resources from plant operation, (6) need for power, and (7) the benefits-cost analysis of the proposed plant operation. (JWR)

21812 (DOCKET-50368-38) ARKANSAS NUCLEAR ONE, UNIT 2. ECCS Improvement Report, Supplementary Information. (Arkansas Power and Light Co., Little Rock). 26 Jan 1973. 2p. Dep. NTIS.

21813 (DOCKET-50373-32) LA SALLE COUNTY STATION, UNITS 1 AND 2. Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Feb 1973. 269p. (Docket-50374-31). Dep. NTIS.

The environmental effects of construction and operation of the La Salle County Nuclear Station Units 1 and 2 are examined. The descriptions include: (1) the environment in the area, including the history, geography and geology, hydrology, climatology, ecology, land and water use including chemical characteristics, (2) the facility and its effluents, (3) the impacts from construction and operation of the unit, (4) alternatives to the proposed action, (5) irreversible and irretrievable long-term commitments of resources from plant operation, (6) need for power, and (7) the benefits-cost analysis of the proposed plant operation. (JWR)

21814 (DOCKET-50382-51) WATERFORD STEAM ELECTRIC STATION, UNIT 3. Responses to Questions on Soils and Foundations. (Louisiana Power and Light Co., New Orleans). 16 Feb 1973. 3p. Dep. NTIS.

21815 (DOCKET-50387-27) SUSQUEHANNA STEAM ELECTRIC STATION, UNIT 1. Limitorque Valve Operators. (Pennsylvania Power and Light Co., Allentown). 9 Jan 1973. 4p. Dep. NTIS.

21816 (DOCKET-50387-28) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Safety Evaluation, Supplement 1. (Directorate of Licensing (AEC), Washington, D. C.). Feb 1973. 36p. (DOCKET-50388-27). Dep. NTIS.

21817 (DOCKET-50395-40) VIRGIL C. SUMMER NUCLEAR STATION, UNIT 1. Safety evaluation, Supplement 2. (Directorate of Licensing (AEC), Washington, D.C). 28 Feb 1973. 6p. Dep. NTIS.

21818 (DOCKET-50404-37) NORTH ANNA POWER STATION, UNITS 3 AND 4. Safety Evaluation, Supplement 1. (Directorate of Licensing (AEC), Washington, D. C.). 21 Feb 1973. 39p. (Docket-50405-37). Dep. NTIS.

21819 (DOCKET-50404-38) NORTH ANNA POWER STATION, UNITS 3 AND 4. Service Water System. (Virginia Electric and Power Co., Richmond). 16 Feb 1973. 12p. (DOCKET-50405-38). Dep. NTIS.

21820 (DOCKET-50404-39) NORTH ANNA POWER STATION, UNITS 3 AND 4. Component Cooling Water System. (Virginia Electric and Power Co., Richmond). 16 Feb 1973. 5p. (DOCKET-50405-39). Dep. NTIS.

21821 (DOCKET-50409-34) LA CROSSE BOILING WATER REACTOR. Limitorque Valve Operators. (Dairyland Power Cooperative, La Crosse, Wis.). 22 Jan 1973. 1p. Dep. NTIS.

21822 (DOCKET-50413-10) CATAWBA NUCLEAR STATION, UNITS 1 AND 2. Environmental Report, Amendment 1. (Duke Power Co., Charlotte, N. C.). 14 Feb 1973. 415p. (Docket-50414-10). Dep. NTIS.

21823 (FIND-50376(1-73)) FIND: AQUIRRE NUCLEAR PLANT, UNIT 1. Revision 1. Gamble, R. L. (Ed.). (Technical Information Center (AEC), Oak Ridge, Tenn.). 30 Jan 1973. 28p. Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (LCL)

21824 (RDT-STATUS-1-73) BIMONTHLY STATUS REPORT: RDT STANDARDS. SUMMARY AS OF JANUARY 31, 1973. (Division of Reactor Development and Technology (AEC), Washington, D. C.). 16 Feb 1973. 46p. RSO.

The Bimonthly Status Report of RDT Standards for the period ending January 31, 1973, which includes RDT standards for Responsible Standards Offices at HEDL, LMEC, and ORNL is presented. (auth)

21825 (WASH-1218(Suppl.1)). ATOMIC SAFETY AND LICENSING APPEAL BOARD ISSUANCES, JULY-DECEMBER 1972. (Atomic Energy Commission, Washington, D. C. Atomic Safety and Licensing Appeal Board). Jan 1973. 135p. Dep. NTIS.

21826 (WCAP-8059) R. E. GINNA NUCLEAR POWER PLANT, UNIT 1. Fuel Densification, Cycle 3. (Westinghouse Electric Corp., Pittsburgh, Pa.). Feb 1973. 102p.

An evaluation of fuel densification and clad flattening in the Ginna power reactor is presented. Predictions for clad flattening in Cycle 3 are given. The power level for future operations is established, and the changes to the Technical Specifications required for such operation were determined. (JWR)

21827 CONSTRUCTION SCHEDULE OF OHII ATOMIC POWER PLANT. Ogawa, Takeshi (Kansai Electric Power Co. Inc., Osaka). Karyoku Hatsuden; 23: No. 2, 155-61(Feb 1972). (In Japanese).

Kansai Electric Power Co. has decided to construct two identical 1,175 MW(e) PWR power plants at Ohii, Fukui prefecture. The first plant will enter commercial operation in about July 1976. The second one will follow 6 months later. Results of observations performed in the fields of geology, meteorology, oceanography and seismology are briefly described together with topographical conditions. An outline of the reactors and layout of buildings are given. Finally, a summary of plant systems is given. The adoption of an ice condenser type container is particularly emphasized from the view points of economy and reliability. Other features of this plant are: (1) Adoption of a boron reproduction system to control the density of boron in the primary coolant. (2) Common use of attached equipment-control room, radiation monitoring system, fuel storage area, the ice condenser system, etc.-by the twin plants. (3) Direct voltage-up to 500 kV. (Japan)

Propulsion and Auxiliary Power Reactors

Refer also to abstracts 19762 and 21858.

21828 (IAE–2139) THEORY OF CAVITY REACTORS WITH COMPRESSIBLE FUEL. 1. DYNAMIC CHARACTERISTICS IN THE CASE OF THE FUEL DENSITY OSCILLATIONS. Novikov, V. M.; Blinkin, V. L. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 18p. (In Russian). INIS.

The effect on reactor dynamics of variations in the fuel density in a reactor with an external moderator was studied. The problem was analyzed by a diffusion-growth approximation using the "effective boundary condition" method. The adiabatic theory of disturbances as applied to a self-coupled equation was used to solve the problem. Variations in the fuel density caused additional reactivity. (tr-auth)

21829 (IAE–2140) THEORY OF CAVITY REACTORS WITH COMPRESSIBLE FUEL. 2. DYNAMICAL REACTIVITY DEPENDENCE UPON REACTOR PARAMETERS. Blinkin, V. L.; Novikov, V. M. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 20p. (In Russian). INIS.

The effect of oscillations in the fuel density in a reactor core with an external moderator on the reactor dynamics was studied. A central-symmetric (in a spherical reactor) and an axial-symmetric (in a cylindrical reactor) acoustic oscillation was considered, and, in addition, acoustic oscillations along the canal axis in a plane reactor. Oscillations in the total mass of fuel were studied, during which a density change occurred simultaneously throughout the volume of the core. The dependence of the magnitude and sign of the dynamic reactivity on the type of oscillation in the fuel density, on moderator parameters, and on the geometry of the system were studied. The relative amplitude of the oscillation in the neutron flux may significantly raise the relative amplitude of the fuel density. (tr-auth)

21830 (N–72-21645) FLOWING GAS, NONNUCLEAR EXPERIMENTS ON THE GAS CORE REACTOR. Phase 1 Topical Report. Kunze, J. F.; Suckling, D. H.; Copper, C. G. (Aerojet Nuclear Co., Idaho Falls, Idaho). Feb 1972. 99p. (NASA-CR–120824; ANCR–1032). NTIS.

Flow tests were conducted on models of the gas core (cavity) reactor. Variations in cavity wall and injection configurations were aimed at establishing flow patterns that give a maximum of the nuclear criticality eigenvalue. Correlation with the nuclear effect was made using multigroup diffusion theory normalized by previous benchmark critical experiments. Air was used to simulate the hydrogen propellant in the flow tests, and smoked air, argon, or freon to simulate the central nuclear fuel gas. All tests were run in the down-firing direction so that gravitational effects simulated the acceleration effect of a rocket. Results show that acceptable flow patterns with high volume fraction for the simulated nuclear fuel gas and high flow rate ratios of propellant to fuel can be obtained. Using a point injector for the fuel, good flow patterns are obtained by directing the outer gas at high velocity along the cavity wall, using louvered or oblique-angle-honeycomb injection schemes. (auth)

21831 (N–72-21646) NEUTRONICS ANALYSIS OF AN OPEN-CYCLE HIGH-IMPULSE GAS CORE REACTOR CONCEPT. Whitmarsh, Charles L. Jr. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Apr 1972. 37p. (NASA-TM-X–2534; E–6390). NTIS.

A procedure was developed to calculate the critical fuel mass, including the effects of propellant pressure, for coaxial-flow gas-core reactors operating at 196,600 newtons thrust and 4400 seconds specific impulse. Data were generated for a range of cavity diameter, reflector-moderator thickness, and quantity of structural material. Also presented are such core characteristics as upper limits on cavity pressure, spectral hardening in very-high-temperature hydrogen, and reactivity coefficients. (auth)

21832 (N–72-21647) AFTER-HEAT DISTRIBUTION OF A MOBILE NUCLEAR POWER PLANT. Final Report. Parker, W. G.; VanBibber, L. E.; Tang, Y. S. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Nov 1971. Contract NAS3-14405. 202p. (NASA-CR–120825; WANL-PR(WWW)–11). NTIS.

A computer program was developed to analyze the transient afterheat temperature and pressure response of a mobile gas-cooled reactor power plant flowing impact. The program considers (in addition to the standard modes of heat transfer) fission product decay and transport, metal-water reactions, core and shield melting and displacement, and pressure and containment vessel stress response. Analyses were performed for eight cases (both deformed and undeformed models) to verify operability of the program options. The results indicated that for a 350 psi (241 n/sq cm) initial internal pressure, the containment vessel can survive over 100,000 seconds following impact before creep rupture occurs. Recommendations were developed as to directions for redesign to extend containment vessel life. (auth)

21833 (N–72-25610) CLOSED-LOOP DYNAMICS OF IN-CORE THERMIONIC REACTOR SYSTEMS. Sawyer, C. D.; Boudreau, J. E. (Jet Propulsion Lab., Pasadena, Calif.). 15 May 1972. Contract NAS7-100. 21p. (NASA-CR–126868; JPL-TM–33-546). NTIS.

Using a point model of an in-core thermionic converter, alternative schemes for providing closed loop reactor control were investigated. It was found that schemes based on variable gain power regulation buffers which use the reactor current as the control variable provide complete protection from thermionic burnout and also provide a virtually constant voltage to the user. A side benefit is that the emitter temperature transients are small. Even for a complete electric load drop the emitter temperature transient is less than 100°K. The current regulation scheme was selected for further study with a distributed parameter model which was developed to account for variations in thermionic and heat transfer properties along the length of a cylindrical converter. It was found that even though the emitter temperature distribution is about 200°K along the converter length, the dynamic properties are unchanged when using the current control scheme. (auth)

21834 (N–72-27721) 1055 FT/SEC IMPACT TEST OF A TWO-FOOT DIAMETER MODEL NUCLEAR REACTOR CONTAINMENT SYSTEM WITHOUT FRACTURE. Puthoff, R. L. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Jun 1972. 25p. (NASA-TM-X–68103; E–6942). NTIS.

A study to determine the feasibility of containing the fission products of a mobile reactor in the event of an impact is presented. The model simulated the reactor core, energy absorbing gamma shielding, neutron shielding and the containment vessel. It was impacted against an 18,000 pound reinforced concrete block at 1055 ft/sec. The model was significantly deformed and the concrete block demolished. No leaks were detected nor were any cracks observed in the model after impact. (auth)

21835 (RN-S-309(Suppl.)(Bk.3)) NRX/EST DATA ANALYSIS REPORT. Glaeser, D. B.; Henschel, A. J.; Slonim, N. H. (Aerojet-General Corp., Sacramento, Calif). Nov 1966. Contract SNP-1. 527p.

Declassified 20 Oct 1971.

Data generated during the NRX/EST series are presented. (JWR)

21836 (RN-S-309(Suppl.)(Bk.4)) NRX/EST DATA ANALYSIS REPORT. Glaeser, D. B.; Henschel, A. J.; Slonim, N. H. (Aerojet-General Corp., Sacramento, Calif.). Nov 1966. 383p.

Declassified 20 Oct 1971.

The data plots generated during the NRX/EST series are presented. (JWR)

21837 (TIM–774) LCRE REACTOR CONTROL SYSTEM-COMPENSATION AMPLIFIER: JOB NO. FED-128-223. Banic, C. V. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 1 Jul 1964. Contract AT(30-1)-2789. 8p. Dep. NTIS.

Declassified 21 Oct 1971.

A Compensation Amplifier was designed as part of the Lithium Cooled Reactor Experiment (LCRE) control system to compensate for the long-time lags associated with the temperature sensing installation. This unit employs two stages of lead-lag network compensation buffered by two stages of magnetic amplifiers. This unit was tested in a simulator of the LCRE control system with satisfactory results. (auth)

21838 (TIM-781) IN-PILE CAPSULE DESIGN REPORT FOR UN FUEL ELEMENT SPECIMENS (TYPE 18B) OPERATING AT 0.4 Kw/cc AND 2000F. Butler, E. N.; Mattrella, U. A.; Thoms, K. R. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 22 Jan 1964. Contract AT(30-1)-2789. 17p. Dep. NTIS.

Declassified 20 Oct 1971.

21839 (TIM–790) LCRE REACTOR CONTROL SYSTEM SUMMING POINT AND ERROR AMPLIFIER. Naples, P. V. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 30 Mar 1964. 10p. Dep. NTIS.

Declassified 20 Oct 1971.

A Summing Point and Error Amplifier capable of receiving a

preamplified temperature or neutron flux signal, comparing this signal with a set reference and producing an error voltage as a result of the comparison was designed and developed for use in the LCRE reactor control system. As a result of evaluation tests performed on the Summing Point and Error Amplifier, it was determined that the unit was suitable for use in the LCRE reactor control system. The design objectives, description of the circuit, system operation and test results are included. (auth)

21840 (TM-67-3-7) 710 REACTOR AUXILIARY LIQUID-METAL COOLANT SYSTEM ACTIVATION AND REACTIVITY WORTH CALCULATIONS. Zwick, J. W. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). 15 Feb 1967. Contract AT(40-1)-2847. 19p. Dep. NTIS. Declassified 3 Nov 1971.

One concept being investigated for cooling the reactor pressure shell of a Brayton cycle space power unit based on the 710 Reactor is a liquid metal coolant system. Calculations were made to determine the activation caused by neutron capture in the liquid metal coolant system and to evaluate the effect of this coolant on the reactivity worth of the radial reflector. The calculational methods are discussed and the results of the calculations are presented. (auth)

21841 FABRICATION OF FUEL FOR NUCLEAR SHIP MUTSU. Sasao, Nobuyuki (Japan Nuclear Ship Development Agency, Tokyo). Genshiryokusen; No. 92, 2305-12(Jun 1971). (In Japanese).

The reactor core of Mutsu consists of 32 fuel assemblies, 12 assemblies with 3.24% enriched uranium and 20 assemblies with 4.44% enrichment. Each assembly consists of 112 fuel rods and 9 burnable poison rods. The fuel rods contain 65 UO_2 pellets. Specifications of the fuel assemblies, fuel rods, and burnable poison rods are given. Fabrication processes of the UO_2 pellets, fuel rods, burnable poison rods, and fuel assemblies are also given. Items and conditions of preliminary tests to evaluate performance of each component are briefly described. The items are: irradiation test of BP glass pipes, welding conditions for the fuel rods and burnable poison rods, integrity test of support grid plates, strength of the assemblies, and shearing strength at welded parts. (Japan)

21842 ELECTRIC APPARATUS FOR NUCLEAR REACTOR ON THE N. S. MUTSU. Umeda, Yasuhiro (Mitsubishi Electric Corp., Nagasaki); Fujita, Hiroshi; Oka, Fujio; Tai, Masateru; Masuda, Masaya. Mitsubishi Denki Giho; 45: No. 7, 891-9 (Jul 1971). (In Japanese).

The N. S. Mutsu, the first ship of the kind built in Japan, is the third realized as a vessel of commerce in the world, following the Savannah in the U.S.A. and the Otto Hahn in West Germany. It is powered by a Mitsubishi PWR type marine reactor plant constructed by purely Japanese techniques and rated at thermal output of 36 MW(t). Mitsubishi Electric Corp. has participated in this project, supplying the principal electric apparatus. The canned motors used for the main coolant pumps, the auxiliary starting panels, the control instrument panels, the automatic controls of reactor power, and the nuclear instrumentation are described. Also, special conditions in the design for safety are discussed. (auth)

21843 PRECOMPUTED STATE DEPENDENT DIGITAL CONTROL OF A NUCLEAR ROCKET ENGINE. Johnson, Morris Ray. Tucson, Ariz.; Univ. of Arizona (1972). 160p. University Microfilms Order No. 72-21,440.

Thesis.

A method of control which is applicable to multiple-input multiple-output nonlinear time-invariant systems in which desired behavior can be expressed explicitly as a trajectory in system state space was developed. The method, called Precomputed State Dependent Control (PSDC), is proposed as a means of controlling a model of the NERVA nuclear rocket engine using an on-line digital computer. The PSDC method is basically a synthesis technique in which a suboptimal control law is developed off-line, prior to system operation. Experiments are conducted to evaluate three aspects of the SNM control system performance: the ability of the system to follow the desired trajectory, its ability to return to this trajectory from distant initial conditions, and the sensitivity of the controller to variations in dominant plant time constants. These experiments indicate that PSDC is a practical and effective means of controlling the Simplified Nonlinear Model of NERVA. The SNM control system exhibits excellent trajectory following properties and is capable of returning to the desired trajectory from nearly any point in state space which is physically realizable. Also, the controller is reasonably insensitive to variations in plant time constants. While the Control Model itself may find little application outside this or similar NERVA studies, the PSDC method is more generally applicable. (Diss. Abstr. Int., B)

21844 SPACE NUCLEAR PLANT. Fiebelmann, P.; Neu, H. (to EURATOM). U. S. Patent 3,709,781. 9 Jan 1973. Priority date 24 May 1968, Belgium. 4p.

A nuclear power plant is described for space stations having a heating core, a reflector at least partially pivotal about the core, and a system of heat pipes penetrating into the core. The heat pipes supply reaction heat to thermionic converters disposed in the reflector zone with heat reflected from the converters being dissipated into space by cooling means. (Official Gazette)

21845 SPACE REACTOR GROUND SAFETY AND CONTROL SYSTEM. Hampel, V. E.; Lee, J. D. III; Walter, C. E. (to United States Atomic Energy Commission). U. S. Patent 3,700,554. 24 Oct 1972. Filed 20 Jun 1968.

A reactivity control system is described for fast nuclear reactors using liquid metal coolant having high and low neutron-absorption cross section components. The system maintains the high neutron-absorption cross section components in solidified form in the coolant channels throughout the reactor core prior to start-up for ground safety and then liquefies and mixes the high neutron absorption component with a low neutron-absorption cross section component to adjust the reactivity to the desired operating level. Reactivity is subsequently grossly adjusted by adding to or replacing a portion of the coolant mixture with additional quantities of one or the other appropriate component. (auth)

21846 MINI-CAVITY REACTOR FOR LOW-THRUST HIGH-SPECIFIC IMPULSE PROPULSION. Hyland, Robert E. (Lewis Research Center, Cleveland). J. Spacecraft Rockets; 9: No. 8, 601-6(Aug 1972).

The mini-cavity reactor is a concept which combines a driver region fueled with NERVA type fuel elements and a central gas core region to obtain high specific impulse (1000–2000 sec) for thrust levels in the 100–900 N range, which is applicable to probe type missions. The dimensions of the reactor, chosen as an example, are: an over-all diameter of 1.21 m including an external spherical pressure shell, and a central gas core cavity diameter of 0.61 m. The combined power level of the driver region and the cavity range from 8.5 MW to approximately 70 MW for various thrust levels and chamber pressures. Powerplant weights, including a radiator for disposing of low grade power in the driver, are between 4600 and 33,000 kg. These weights are within the payload capabilities of the space shuttle. It is apparent that this reactor could also be used as a possible test reactor for the gas-core reactor and for testing and coupling with MHD devices. (auth)

21847 EXTRATERRESTRIAL PROPELLANT RESUPPLY FOR ADVANCED MANNED MISSIONS. Heppenheimer, T. A. (Univ. of Michigan, Ann Arbor). Astronaut. Aeronaut.; 10: No. 11, 60-7(Nov 1972).

The hydrogen propellant requirements for manned deep space missions using NERVA propulsion systems are analyzed. The use of an SPR-6 reactor for hydrogen production during the deep space missions is discussed. 33 references. (DCC)

21848 RESEARCH WORK ON SHIP-BUILDING TECHNOLOGY FOR THE SAFETY OF NUCLEAR-POWERED MERCHANT SHIPS. Woisin, G. (Gesellschaft fuel Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geestacht, Ger.). Schiff Hafen; 23: No. 12, 947-950(1971). (In German). (GKSS-72/E/7).

The safety of nuclear ships is discussed with respect to collision protection and sinking speed. Protection of the reactor is the most important additional safety consideration required for nuclear ships. Impact mechanics are dealt with. Collision tests using strength models are discussed. The design of collision safety equipment for smaller ships such as the Otto Hahn and Savannah, as well as for larger ships, is described. Investigations on sinking velocity and flooding of the containment system are discussed briefly. (auth)

21849 STUDIES ON COLLISION-PROTECTIVE STRUCTURES IN NUCLEAR POWERED SHIPS. Akita, Y. (The Ship Classification Society of Japan, Tokyo); Ando, N.; Fujita, Y.; Kitamura, K. Nucl. Eng. Des.; 19: No. 2, 365-401(1972).

From first international conference on structural mechanics in reactor technology; Berlin, Germany (20 Sep 1971). See CONF-710903-(Vol.19,No.2).

For the purpose of obtaining design criteria for collision-protective side structures installed in nuclear powered ships, various series of tests and theoretical analyses were carried out. Fracture types of side structures could be grouped into two types such as deformation and crack ones. Discrimination of fracture, estima-

tion of load, and absorbed energy against penetration depth were formulated. The dynamic effects could be explained well with the increase in yield stress of steel. The relationship between added mass of water and elapsed time of collision was analyzed. The influence of the strength of a stem of the striking ship could be examined with the strength ratio of the stem to the side structure and semi-experimental formulae of the energy absorption were obtained. The influence of the stem angle and penetration angle to the energy absorption was found to be small. The condition required for the side structures to have large energy absorption was discussed using the model tests of various side structures. (auth)

21850 COMPARISON OF ADVANCED PROPULSION CONCEPTS FOR DEEP SPACE EXPLORATION. Moeckel, W. E. (Lewis Research Center, Cleveland). J. Spacecraft Rockets; 9: No. 12, 863-8(Dec 1972).

Equations and charts are presented which permit rapid estimation of propulsion system performance requirements for some typical deep space missions. The simplicity results from use of gravity-free equations of motion, which are shown to yield good approximations to trip times obtained with solar gravity and planetary motion included. The agreement is satisfactory for missions that do not enter or depart from low orbits about the major planets. A number of advanced propulsion concepts for which performance estimates are available are compared with respect to their capability for fly-by, rendezvous, and round-trip planetary missions. Based on these estimates, the gas-core nuclear fission rocket and the pulsed fusion rocket yield the fastest trip times to the near planets. For round trips to Jupiter and beyond, the controlled fusion rocket shows progressively superior capabilities. Several propulsion concepts based on use of impinging laser beams are found to be noncompetitive with the other advanced concepts for deep space missions. 13 references. (auth)

21851 BUOYANCY EFFECT ON FUEL CONTAINMENT IN A GAS-CORE NUCLEAR ROCKET. Putre, H. A. (Lewis Research Center, Cleveland). J. Spacecraft Rockets; 9: No. 12, 932-4(Dec 1972).

Process Heat and Desalination Reactors

21852 NUCLEAR ENERGY FOR PROCESS HEAT UTILIZATION. Schulten, R. (Kernforschungsanlage, Juelich, Ger.). Atomwirt., Atomtech.; 17: No. 9-10, 491-4(1972). (In German).

Heat from nuclear energy plants possesses considerable economic advantages over that produced by fossil fuels. Nuclear heat thus offers itself as a promising energy source for liquification and gasification of solid fuels. Valuable experience about technical feasibility of nuclear process heat procedures is gained on the AVR reactor in combination with experimental studies of the KFA Juelich. From conventional installations, extensive experience is available about peripheral arrangements and procedures which, partially, can be directly applied to nuclear plants. (tr-auth)

21853 TECHNICAL PROBLEMS OF MULTI-PURPOSE LIGHT WATER REACTOR. PROBLEMS OF WATER RESOURCES AND DESALTING SEA WATER. Motoya, Y. (Public Utility Board, Yokohama, Japan). Genshiryoku Kogyo; 18: No. 4, 7-13(Apr 1972). (In Japanese).

Problems of water resources may become serious in the near future in Japan. Desalting of seawater seems to be most promising to supply large amounts of water of good quality. The evaporation method is most profitable for large scale processing, and the multi-stage flush method is discussed. Dual purpose plants combined with nuclear power plants in which seawater is heated by exhaust steam from power turbines have received attention recently. In the near future the cost of water supplied from the dual purpose desalting plants would come to be less than that supplied by natural resources. Desalted water may be supplied not only for living uses but also for industrial uses. The ratio of water production to generated power is decided according to demand. The electric power generated by the dual purpose plants is not suitable to meet load fluctuation, and should be applied to base load operation. The water demand, which shows seasonal variation, can be supplied by a combination of output from natural resources and desalting plants. The capacity of plants which may be required for producing water in the future is estimated. (JA)

Research and Test Reactors

Refer also to abstracts 20038, 21165, 21571, 21572, 21617, 21642, and 21895.

21854 (ANCR-1088) NUCLEAR TECHNOLOGY DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JUNE 30, 1972. (Aerojet Nuclear Co., Idaho Falls, Idaho). Oct 1972. Contract AT(10-1)-1375. 502p. Dep. NTIS.

Included are 8 sections describing progress in technical programs. A separate abstract was prepared for each section. (HDR)

For abstracts of individual sections see: 19857, 19933, 21105, 21149, and 21855-21858.

21855 (ANCR-1088, pp 81-247) TEST REACTOR OPERATIONS SUPPORT. Oct 1972.

In Nuclear Technology Division annual progress report for period ending June 30, 1972.

ADVANCED TEST REACTOR—operation during fiscal year 1972
—control shims for, hafnium burnup in, (E)
—neutron reflector damage in, flux and reactivity effects of, (T)
—in-pile tubes of, reactivity effects of material insertion in, (E)
—neutron flux trap facility in, power distribution effects of, (E)
—neutron reflector damage in, coolant flow redistribution from, (T)
—instrumentation for, development of
—fuel plates for, analysis of boron-10 in., (E)
—instrumentation for, noise band scanner for surveillance of
—protection system for, performance of Log-N amplifier in, (E)
CRITICAL ASSEMBLIES—neutron flux in reflector of ATRC, effects of shim position on, (E)
—fission chamber power response in ATRC, effect of core position on, (E)
—control shims of ATRC, effects of core position on differential worth of, (E)
—power distribution in ETRC, (E)
—fuel fission density ratios in ETRC, (T)
—poison wands for ETRC, boron content of plastic, (E)
—physics parameters of ETRC, (E/T)
ENGINEERING TEST REACTOR—physics parameters of, (E/T)
—fuel element testing in, Fuel Element Failure Propagation Loop for
—fuel elements for, power density profiles in, (E/T)
—fuel recycle program for
—neutron filters in, thermal flux reduction by cadmium, (E)
—power distribution in, effects of regional poisoning on, (E)
—power distribution in, (E)
—neutron flux monitoring in, performance of self-powered detectors for, (E)
—operation during fiscal year 1972
REACTOR FUEL ELEMENTS—cladding for plate-type, thickness measurement methods for, (E)
—fuel content in pin-type, nondestructive quality assurance analysis of, (E) (HDR)

21856 (ANCR-1088, pp 249-58) LOFT SUPPORT. Oct 1972.

In Nuclear Technology Division annual progress report for period ending June 30, 1972.

REACTOR SAFETY EXPERIMENTS—development of LOFT during fiscal year 1972
—simulation of LOFT, hybrid computer models for (HDR)

21857 (ANCR-1088, pp 259-68) PBF SUPPORT. Oct 1972.

In Nuclear Technology Division annual progress report for period ending June 30, 1972.

POWER BURST FACILITY—development during fiscal year 1972
—fuel pins for, irradiation testing of
—control bridge displacement measurements for
—fuel enrichments for, method for calculation of (HDR)

21858 (ANCR-1088, pp 269-340) OTHER REACTOR DEVELOPMENT AND SUPPORT. Oct 1972.

In Nuclear Technology Division annual progress report for period ending June 30, 1972.

NEUTRON CROSS SECTIONS—evaluation of ENDF/B, for reactor calculations
NEUTRON SOURCES—use of californium-252, for activation analysis and neutron radiography
NEUTRONS—scattering cross sections for uranium-238, effects of resonance self-shielding on, (T)
REACTORS—physics calculations for, evaluation of ENDF/B data for
REACTORS, BOILING—cooling systems for, measurement of fission product inventories in

—radioactive effluents from, measurement of fission product inventories in
REACTORS, GAS FUELED—design of gas core, (T)
—neutron reflector for gas core, γ heating in beryllium oxide, (E/T)
—core flow patterns in gas core, simulation of
REACTORS, RESEARCH—neutron reaction and fission rate measurements in CFRMF
—power density distribution measurements in CFRMF
—reactivity worth in CFRMF, spatial dependence of small-sample, (E)
—reactivity temperature coefficient measurements in CFRMF
—neutron flux spectra in CFRMF, Monte Carlo calculations of, (E/T)
—power level control and monitoring system performance in CFRMF
REACTORS, ROCKET—core flow patterns in gas core, simulation of
—design of gas core, (T)
—neutron reflector for gas core, γ heating in beryllium oxide, (E/T)
URANIUM 238—neutron scattering cross sections for, effects of resonance self-shielding on, (T) (HDR)

21859 (BLG-467, pp 7.1-40) BR2 MATERIALS TESTING REACTOR AND ITS ASSOCIATED FACILITIES.

BELGIAN REACTOR-2—operation during 1971, summary of
—operating incidents during 1971
—irradiation facilities of, development of (HDR)

21860 (BLG-467, pp 9.1-16) TECHNICAL SUPPORT.

21861 (BNWL-CC-87) INTERIM REPORT ON HTLTR MOCKUP RUN NUMBER 1. Kreiter, M. R. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab). 9 May 1965. 4p. Dep. NTIS.

Large mockup Run Number 1 has been completed and the results partially analyzed. In general, the run proved satisfactory with the graphite core being heated to a maximum average temperature of 1070°C. At this time the minimum and maximum temperatures were about 1050°C and 1130°C, respectively, depending upon the thermocouple location within the graphite core. (auth)

21862 (COO-2144-4) UNIVERSITY OF WISCONSIN REACTOR SHARING PROGRAM. Technical Progress Report, April 1, 1972–November 30, 1972. (Wisconsin Univ., Madison). [nd]. Contract AT(11-1)-2144. 25p. Dep. NTIS.

Experimental programs carried out in the University of Wisconsin Research Reactor during April to November 1972 are reviewed. (DCC)

21863 (COO-3019-3) SEMIANNUAL PROGRESS REPORT, MARCH 1, 1972–August 31, 1972. (Harvard Univ., Boston, Mass. Harvard Air Cleaning Lab.). Oct 1972. Contract AT(11-1)-3019. 33p. Dep. NTIS.

Data gathered in a series of tests using a model ventilating system and heat exchangers which simulate as closely as possible the equipment configurations, flow rates, and aerosol characteristics under consideration for the FFTF are presented. Data on dynamic adsorption coefficients for krypton on activated charcoal from streams of argon and helium at temperatures ranging from −140°C to 0°C and at pressures from 15 psig to 135 psig are included. Similar determinations were made for xenon but only at 37°C because measurements were not practicable at low temperatures. The data show that the adsorption coefficient is considerably higher from helium streams than from argon at all temperatures and pressures studied, and in both cases it increased markedly as the temperature is decreased. (auth)

21864 (DOCKET-50231-130) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR. Technical Specifications, Intrusion Alarm Sensors. (Directorate of Licensing (AEC), Washington, D. C.). 7 Feb 1973. 2p. Dep. NTIS.

21865 (EIR-226) ANALYSIS OF SINGLE FUEL ELEMENT MEASUREMENTS MADE IN PROTEUS. Koehler, P.; Richmond, R. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Nov 1972. 24p. Dep. NTIS (U. S. Sales Only).

A series of experiments has been carried out in the reactor PROTEUS of the type in which a single fuel element is introduced into a dissimilar reactor environment and measurements are made of relative neutron reaction rates in the fuel element and of its reactivity worth. The analysis of such an experiment can give a check on the basic data and methods of a scheme of reactor lattice calculation. The test fuel elements were placed at the center of a D_2O-moderated lattice of natural UO_2 rod cluster elements. The test fuel elements themselves were in the form of rod clusters of natural or enriched UO_2 or of PuO_2/UO_2. The relative values of the ^{238}U capture and ^{235}U fission rates and (for the PuO_2/UO_2 clusters) the ^{239}Pu fission rate were measured at the central plane of the test cluster. The reactivity worth of each test cluster was also measured relative to the worth of a dilute boron calibration sample. 10 references. (auth)

21866 (GEAP-13850) SPECIFICATION OF ZPPR ASSEMBLY 3, PHASE 1 EXPERIMENTAL PROGRAM. Bailey, H. S.; Stewart, S. L. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Oct 1972. Contract AT(04-3)-189. 44p. Dep. NTIS.

The scope of the ZPPR Assembly 3 is described. The Assembly 3 experimental configurations are also described and discussed. The final Phase I experimental specification of ZPPR-3 is presented. (auth)

21867 (HEDL-TME-72-116(Vol.1)) FACILITY DESIGN DESCRIPTION OF THE PROTOTYPE APPLICATIONS LOOP. Owens, T. J.; Lester, D. H.; Bennett, D. W. (Hanford Engineering Development Lab., Richland, Wash.). 1972. Contract AT-(45-1)-2170. 287p. Dep. NTIS.

Information on the Prototype Applications Loop for developing in-line chemistry monitoring instruments for the FFTF is presented. Design parameters, operations aspects, and quality assurance requirements for Prototype Applications Loop are included. (DCC)

21868 (INR-P-980) CALCULATION METHODS FOR WWR-SM LATTICES. Kowalska, K. (Institute of Nuclear Research, Warsaw (Poland)). 1968. 39p. Dep. NTIS (U. S. Sales Only).

Micro- and macroscopic calculations were made for the experimental cores on the WWR-SM critical assembly MARYLA-2. Both tightly and loosely packed lattices were investigated, "clean" cores, homogeneously poisoned cores, and cores with control rods. The considered configurations comprised cores with water or beryllium-water side reflector, with or without upper water reflector, and also with partly "dry lattice." Critical number of fuel elements or critical water levels, buckling values, reactivity worth of control rods, spectral indices, micro- and macroflux distributions were calculated. Various approximations of the actual fuel and core configurations, and various calculational methods were discussed. 14 references. (auth)

21869 (JUL-835-RE) INCREASED POWER OF THE FRJ-1 TO 10 MW. RESULTS OF THE PRELIMINARY EXPERIMENTS. Bormann, H. J.; Kalker, K. J.; Katscher, W.; Muench, E. (Kernforschungsanlage, Juelich (West Germany). Zentralabteilung Forschungsreaktoren). Mar 1972. 141p. (In German). Dep. NTIS (U. S. Sales Only).

Described are measurements on the FRJ-1 reactor after its modification for power increase to 10 MW. Results are reported about core configuration, flow distribution of cooling medium, thermal neutron flux, reactivity, and control rod behavior. Also described are temperature measurements on a fuel element with special instrumentation which was inserted at various positions in the core. In addition, data are given for reactivity of newly charged fuel at various positions, spacial distribution of reactivity for a cadmium control rod in the core, as well as the flux of fast and thermal neutrons in experimental installations. (HBG)

21870 (NIIAR-P-110) ESTIMATION OF THE TRANSURANIUM ELEMENT YIELD DURING IRRADIATION OF Pu IN THE SM-2 REACTOR CENTRAL CHANNEL. Gabeskiriya, V. Ya.; Gryzin, Yu. I.; Gryzina, V. V.; Levakov, B. I.; Polyukhov, V. G.; Yakovlev, G. N. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1971. 14p. INIS.

21871 (ORNL-4811, pp 78-81) HPRR AND ACCELERATOR OPERATIONS. Haywood, F. F.; Ward, D. R.; Fox, W. F.; Littleton, C. P.; Poston, J. W.; Robinson, E. M.; Shoup, R. L. Sep 1972.

In Health Physics Division annual progress report for period ending July 31, 1972.

The use of the Health Physics Research Reactor to provide simulated nuclear excursions to allow intercomparisons of accident dosimetry systems is described. (HDR)

21872 (TM-67-3-1) LTFF-13 TEST OPERATING REPORT. Blevins, R. E. (Oak Ridge National Lab., Tenn.). Jan 1967. Contract AT(40-1)-2847. 18p. Dep. NTIS.

Declassified 3 Nov 1971.

The objectives of the test LTFF-13 were to determine the physical integrity and fission product retention capabilities of a Mo-50Re clad, 40 Mo/60 UO_2 fueled specimen when irradiated at a

temperature of 1650°C (3000°F) in the C-28 facility of the LITR. The test specimen, test conditions, instrumentation, and pre-irradiation bench tests are described. The operating history is summarized and tabulated data on the reactor operating history is presented. (LCL)

21873 (WASH-1517) LOSS OF FLUID TEST FACILITY AT THE NATIONAL REACTOR TESTING STATION. Environmental Statement. (Atomic Energy Commission, Washington, D. C.). Jan 1973. 116p. Dep. NTIS.

The environmental effects of the operation of the Loss of Fluid Test facility at the National Reactor Testing Station are evaluated. The analysis includes: (1) background information giving a detailed description of the facility, anticipated benefits, and characterization of the existing environment, (2) the environmental impact, (3) unavoidable adverse environmental effects, (4) alternatives to the facility, (5) the relationship between short-term uses and long-term productivity, (6) state, local, or regional conflicts, (7) irreversible and irretrievable commitments of resources, and (8) a cost-benefit analysis. (JWR)

21874 ANALYTICAL TREATMENT OF NEUTRON AGE IN PERPENDICULAR DIRECTION IN SLAB LATTICES. Kalimullah (Univ. of Cincinnati); Ram, K. S.; Srikantiah, G. Nucl. Sci. Eng.; 49: No. 3, 376-84(Nov 1972).

A closed form expression for the Laplace transform of lethargy-dependent neutron age $\tau_\perp(u)$ from zero lethargy to any lethargy u in a slab lattice of two materials, which are characterized by constant cross-sections, is obtained by solving Fermi age equation with a plane neutron source at the midplane of one of the slabs of an infinite lattice. Due to complexity of the Laplace transform obtained for $\tau_\perp(u)$, numerical inversion is carried out to obtain (a) neutron age from 2 MeV to indium resonance energy 1.45 eV in a number of Al–H_2O lattices ranging from pure aluminum to pure water and (b) neutron age as a function of lethargy in 5-5 cm Al–H_2O lattice. The results obtained are in satisfactory agreement with the existing literature in those few cases in which experimental or Monte Carlo values are available. At the same Al–H_2O volume ratio, neutron age is found to increase or decrease with increasing plate thickness depending on the neutron source location in aluminum or water respectively. Furthermore, everything remaining the same neutron age is smaller with the source in water than in aluminum. (auth)

21875 LOCAL NUCLEAR REACTOR POWER MEASUREMENTS USING GAMMA-RAY FLUCTUATIONS. LeVert, F. E. (Tuskegee Inst., Ala.); Schultz, M. A. Nucl. Sci. Eng.; 49: No. 2, 188-201(Oct 1972).

Local measurements of the inherent fluctuations in the gamma-ray density at specific locations in the core of the Pennsylvania State Triga Reactor have been conducted using two externally located detectors. Local power was determined for positions up to the center of the core from a distance of approximately 200 cm by measuring the zero-time cross correlation function in small intervals. Voids introduced by the removal of single fuel elements were readily located and mapped. Single collimator dc scans along diagonal rows in the core were successful in resolving the individual rows of fuel in the core. A comparison between the neutron distribution predicted by two dimensional multi-group diffusion theory and a single collimator measurement showed very good agreement in their respective shapes. Cospectral densities were obtained for the two cases where the collimators focused on and off a volume of fuel in the core. The frequency response data indicated, when interpreted in terms of an analytical model, that the observed output fluctuations were caused by temperature and coolant flow input fluctuations. (auth)

21876 NUCLEAR PROPERTIES AND STUDY PLAN OF FAST NEUTRON REACTOR YAYOI IN UNIV. OF TOKYO. An, S. (Tokyo Univ.). Genshiryoku Kogyo; 18: No. 2, 25-30(Feb 1972). (In Japanese).

"YAYOI" is a fast neutron reactor which reached criticality on April 10, 1971. This reactor has the following characteristics; maximum thermal power is 2 kilowatts, maximum neutron flux is 0.8×10^{12} n/cm^2·sec. The fuel employed is 93% enriched uranium metal in a cylinder of 124 millimeter diameter. The sheath is stainless steel. The reflector is lead. Control rods comprise two safety rods, two shim rods, and one regulation rod of 0.4 percent enriched uranium. Core cooling is performed by air. As the core can be transferred backward and forward, various fields of neutrons can be obtained. Moreover, by generating pulsed neutron fields and modified neutron fields, experiments on the time-of-flight method and neutron wave propagation can be performed. The study plan with "YAYOI" is as follows; basic studies on fast breeding reactor, studies on radiation shielding, development of measuring instruments for radiation, and studies on irradiation effects of fast neutrons. (Japan)

21877 CONCEPTUAL DESIGN OF OARAI GAS LOOP-1 (OGL-1). Nomura, Sueo (Japan Atomic Energy Research Inst., Oarai); Ouchi, Shinpei; Izaki, Takashi; Nakai, Yasuo. FAPIG (Tokyo); No. 64, 233-40(Feb 1972). (In Japanese).

OGL-1 is an in-core high temperature helium gas loop which is planned to be connected to the Japan Material Test Reactor, and this loop is designed to be used for irradiation tests of fuels and materials of multipurpose high temperature gas cooled reactors and for chemical tests of the coolants. Its maximum design temperature is 1100°C and pressure is 30 kg/cm^{2}G. The conceptual design of OGL-1 was finished in 1970, detailed design in 1971, and in 1975 the construction is scheduled to be finished. This loop is composed of an in-core loop and an out-core loop. The in-core loop consists of an in-core sample irradiation section, vertical pipes, branch pipes, etc. Each section has a multipipe structure consisting of a temperature-proof wall, pressure wall, and an overcoat pipe. The out-core loop has a primary cooling system to preserve the fixed conditions, a secondary cooling system, a gas refining system, helium supply and exhaust systems, measurement and control systems, etc. As heat-resisting materials exposed to the high temperature helium, the ferro alloys and nickel alloys were tested. The centrifugal coated pipe (HK-40) of 25 Cr–20 Ni has a good characteristic of high temperature strength. Incoloy-800 is inferior to HK-40 regarding high temperature strength, but can be used below 1000°C. As super heat-resisting alloys, the nickel alloys such as inconel and hastelloy are most employed. (Japan)

21878 EFFECTS OF VOIDS ON REACTIVITY AND REACTOR STABILITY. Lall, Prithvi C.; Kadaba, Prasad K.; Bhattacharyya, Tarak J. (Univ. of Kentucky, Lexington). Indian J. Phys.; 45: No. 10, 466-76(Oct 1971).

Using the TRIGA reactor, an attempt has been made to measure the time-dependent change in reactivity in addition to the average change in reactivity as a result of the introduction of voids into the core of the reactor. A positive void coefficient was observed when the compressor speed was at 12.6 cycles/minute, whereas at other speeds negative void coefficients resulted. A study of power fluctuations versus position of the gas valve has been made, and it is concluded that the maximum void effect results when the gas valve is in the middle of the core. The problem has been simulated on an analog computer using the one-delayed neutron group model and using for k'_{ex} the excess reactivity, various forms such as $\sin^2 x$ and chopped sine function in order to obtain agreement with experimental results. The results indicate, qualitatively, oscillatory behavior of power fluctuations with a constant average decrease in power. Suggestions for modifying the experiment are indicated. (auth)

21879 DEVELOPMENT OF CONTROL ROD DRIVE MECHANISM FOR ADVANCED THERMAL REACTOR. Sasaki, Masayoshi (Hitachi Ltd., Ibaraki, Japan); Maetani, Hiromichi; Sato, Haruo; Soejima, Hiroyuki; Ishikawa, Yoshio. Hitachi Hyoron; 54: No. 3, 213-17(Mar 1972). (In Japanese).

The trial manufacture and a series of performance tests of control rods and its drive mechanism for the prototype advanced thermal reactor "Fugen" were introduced. The control rod consists of fine pipes filled with boron carbide and bundled in a double cylindrical tube. The safety rod is the same as a power regulating rod. The control rod is lifted by the hoisting machine with a stainless steel cable. The electromagnetic clutch is equipped for the scram of a reactor. The torque characteristics of static friction, time response, and the temperature characteristics of the electromagnetic clutch were measured. The rising-up velocity of a control rod is 60.9 to 61.1 mm/sec. and going-down velocity 61.8 to 62.4 mm/sec. The response time of switching is 0.124 to 0.530 second in pulling of a rod and 0.075 to 0.240 second in inserting. In a scram test, the clutch switching response time by the electromagnetic relay, is 0.151 to 0.072 second at the coolant flow zero, and the eighty percent inserting time of a control rod is 1.36 second at the coolant flow 19.4 m/hour. This inserting time is 0.15 second shorter than that at zero coolant flow. The shorter inserting time is due to the acceleration and reduction gear and the dash-pot. The location detector with linear differential coils had a measuring accuracy of 0.6%. As a result, this experimental equipment has been verified to satisfy the required conditions for "Fugen". (Japan)

21880 DETERMINATION OF THE FAST NEUTRON SPECTRUM AT THE L54 REACTOR CORE CENTRE. Dierckx, R. (CCR-EURATOM, Ispra, Italy); Guidetti, D.; Nimis, M.; Sangiust, V.; Terrani, M. Energ. Nucl. (Milan); 20: No. 1, 49-52(Jan 1973).

The fast neutron spectrum in the core of the L54 reactor was determined by the activation technique using nine threshold detectors. The reaction rates were derived intercalibrating these detectors in the standard spectrum from the converter DG 65

at the Ispra Centre of Euratom. The experimental data were treated with the unfolding codes SAND II and SPECTRA. 10 references. (auth)

21881 GAS CHROMATOGRAPHIC MEASUREMENTS IN THE FIELD OF NUCLEAR RADIATION. Barnov, V. A.; Tsetskhladze, T. V. pp 90-99 of Yaderno-Khimicheskie Yavleniya v Tverdykh Telakh. Tbilisi, USSR; Izdatel'stvo Metsniereba (1972). (In Russian)

A device is described for making nonanalytical gas chromatographic measurements in the channels of a nuclear reactor in fields of neutrons or γ radiation. The optimal geometry of a column, filled with an adsorbent put into the channel with a thermostat, was determined in accordance with the sizes of the reactor channels and the distribution of the radiation flux along the vertical. Blocks of the device are placed at comparatively large distances. While choosing construction materials, their possible activation by neutrons and their interaction with the studied substance were taken into account. The device was automated to provide radiation safety. (auth)

21882 TEMPERATURE CONDITIONS FOR SILICON OXIDE IRRADIATION IN A NUCLEAR REACTOR CHANNEL. Nadirashvili, L. Sh.; Amiridze, Sh. I.; Somorova, T. M. pp 115-118 of Yaderno-Khimicheskie Yavleniya v Tverdykh Telakh. Tbilisi, USSR; Izdatel'stov Metsniereba (1972). (In Russian)

Time of establishment of the mean equilibrium temperature was measured in the irradiation in a low-temperature channel of the reactor of quartz ampules containing silicon oxide. This time was found to be dependent on the temperature regime of the channel. At low temperatures, it reached several minutes, while for an increase of the channel temperature it increases, reaching 120 minutes under conditions of ambient reactor temperatures. The mean equilibrium temperature of the sample reaches 460°K. (auth)

21883 MEASUREMENT OF BUCKLING AND SPECTRAL INDICES. Campan, J. L.; Bosser, R.; Brunet, J. P.; (and others) (CEN, Cadarache, France). Bull. Inform. Sci. Tech. (Paris); No. 170, 5-20(May 1972). (In French).

The methods used by the Critical Reactor Experiment Service at Cadarache to study thermal and fast neutron reactor physics are presented. The use of miniature fission chambers is outlined. The measured parameters are analyzed and the results are used to establish nuclear data tables. (France)

21884 NEUTRON BALANCE MEASUREMENT USING THE $K_\infty = 1$ METHOD. Bouchard, J. (CEN, Fontenay-aux-Roses, France); Lapparent, D. Bull. Inform. Sci. Tech. (Paris); No. 170, 31-5(May 1972). (In French).

The method described has been used to study the fast multiplying media of Ermine and to study the HTR lattices in Marius. The basic ideas behind the method are described. Its advantages reside in the fact that it provides accurate measurements of the neutron balance and that only small volumes of material are required. (France)

21885 CRITICAL EXPERIMENTS FOR THE BROOKHAVEN PULSED FAST REACTOR STUDY. Phelps, J.; Windsor, H.; Takahashi, H.; Conant, J.; Chandramoleswar, K. (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng.; 49: No. 3, 274-300(Nov 1972).

Measurements using a fast critical assembly were performed in conjunction with the Brookhaven Fast Research Reactor Study. Cores made of highly enriched uranium, stainless steel, and aluminum, reflected mostly by stainless steel were used to obtain broad survey information, and, concurrently, to test the preliminary theoretical model. Quantities measured included critical mass, characteristics of movable reflector blocks, prompt neutron lifetime, worth of materials in potential control positions, neutron yield for a given power, and moderator block characteristics; the first three of these have been compared with calculations. (auth)

21886 NOTE ON OPTIMIZATION OF A STATIONARY REFLECTOR IN A PULSED FAST REACTOR. Kuprin, B. I.; Shabalin, E. P. This paper summarized in At. Energ. (USSR); 31: No. 5, 505(Nov 1971) as paper No. 534/6091. (In Russian).

Full copy of this paper is held by TIC.

The effect of different reflector materials on the effective mean lifetime of prompt fission neutrons was examined; the reflectors ranged from 0 to 25 cm in thickness and the reflector materials were: aluminum, iron, tungsten, nickel, beryllium. Also examined was the effect of various shielding interlayers placed between the core and moderator and serving to diminish the effect of moderator on the effective mean lifetime of the neutrons, on the yield of thermal neutrons. The calculations were carried out in two programs: a many-group program (18 groups) in the P_1-approximation of the method of spherical harmonics, and a three-dimensional many-group program using the Monte Carlo method. (auth)

21887 NOISE MEASUREMENTS IN THE MOATA REACTOR. Kemeny, L. G. (Univ. of New South Wales, Kensington, Australia). J. Nucl. Sci. Technol. (Tokyo); 9: No. 11, 691-3(Nov 1972).

The MOATA research reactor belongs to the University Training Reactor family with a two slab fuel loading and an inter-slab spacing of 18 in. Neutron noise analysis techniques have been used to establish the dynamic characteristics of the system and to assess the physical parameters of the normal core. It is proposed to use similar techniques for measurements on experimental lattices using a reactor as a neutron source. The results presented represent a preliminary assessment and calibration of both technique and equipment. 4 references. (auth)

21888 CRITICAL FACILITY: A POWERFUL NEW REACTOR PHYSICS RESEARCH TOOL FOR LUCAS HEIGHTS. McCulloch, D. B. (Australian Atomic Energy Commission, Lucas Heights). At. Energy Aust.; 15: No. 4, 2-14(Oct 1972).

A general description is given of the principles, uses, safety considerations and design of the split-table facility at A.A.E.C. Some of the loading test results from commissioning are tabulated. (AT)

21889 MEASUREMENTS OF THE EFFECTIVE DELAYED-NEUTRON FRACTION IN TWO FAST CRITICAL EXPERIMENTS. Carpenter, S. G.; Gasidlo, J. M.; Stevenson, J. M. (Argonne National Lab., Idaho Falls, Idaho). Nucl. Sci. Eng.; 49: No. 2, 236-9 (Oct 1972).

The effective delayed-neutron fractions of ^{235}U and ^{239}Pu have been determined for two fast critical assemblies from measurements of the absolute fission rate and the apparent reactivity worths of a calibrated ^{252}Cf neutron source. The experimental values of β_{eff} for the two fissile isotopes, 0.0078 to 0.00233, respectively, are in reasonable agreement with calculations. The results do not explain the 30% discrepancy in measured and calculated reactivity values in fast critical experiments. (auth)

21890 PURNIMA: A Zero Energy Fast Reactor at Trombay. Nucl. India; 10: No. 10-11, 4-8(Jun 1972).

The plutonium reactor for neutronic investigations in multiplying assemblies (PURNIMA), developed by the Bhabha Atomic Research Centre, Bombay, India, is described. It is a zero energy fast reactor in which the neutron chain reaction is carried on mostly by fast neutrons of energy greater than 100 keV. The mean prompt neutron life-time 'l' is 5×10^{-8} secs and it places stringent requirements on the performance of the control system. The main reactor protection devices are the core drop mechanism and the three independent banks of safety rods. The reactor is housed in a concrete vault and operated remotely. The nuclear instrumentation used is fully transistorized and special attention has been taken to the radiological safety aspect. To provide fuel the core vessel is transported to a leading jig, and criticality was confirmed when the reactor power was divergent with a doubling time of 140 secs. A controlled self-sustaining fast neutron chain reaction was established for the first time in India. This experimental reactor contains neither uranium nor thorium and it does not breed. At very low power levels, both the consumption and production of fissile materials is negligible, but this experimental facility would provide the experience and basic know-how, particularly in the domains of physics and control of fast neutron reactors. (INIS)

21891 CONSTRUCTION AND DOSIMETRY OF BIOLOGICAL IRRADIATION FACILITIES AT LIGHT-WATER MODERATED REACTORS. Makra, S. (Central Research Inst. for Physics, Budapest); Zarland, P. pp 41-50 of Radiobiological Applications of Neutron Irradiation. Vienna; International Atomic Energy Agency (1972).

From Meeting on radiobiological applications of neutron irradiation; Vienna, Austria (6 Dec 1971). See STI/PUB-325; CONF-711204.

Different possible constructions for biological irradiation facilities and two versions developed in the Central Research Institute for Physics, Budapest, are discussed. The reactor used is a light-water moderated and cooled thermal reactor of the WWR-S type. The first irradiation facility made use of a 100-mm diam. horizontal beam tube, the dose rate was of the order of magnitude of 1 rad/s but the homogeneity of the field was not sufficient for class A irradiation. The second version has an enlarged beam diameter of 150 mm; the dose rate and the neutron/gamma ratio can be altered by changeable bismuth filters and the homogeneity of irradiation is fairly good. Measurement methods include G-M tube monitors, activation and TLD techniques, while neutron spectrum and kerma calculations are performed with a code that computes the spectrum of the core modified by different filters. Measured data are evaluated by using a fitting code. Various effects

influencing dose-rate stability, i.e., displacement of absorbers inside the core (control rods, cadmium-encapsulated specimen, etc.), reactor poisoning, burn-up and refuelling, are discussed. (auth)

21892 CONVERSION OF REACTOR NEUTRONS TO 15 MeV WITH LiD. Frigerio, N. A. (Argonne National Lab., IL). pp 51-6 of Radiobiological Applications of Neutron Irradiation. Vienna; International Atomic Energy Agency (1972).

From Meeting on radiobiological applications of neutron irradiation; Vienna, Austria (6 Dec 1971). See STI/PUB-325; CONF-711204.

A system is proposed for the conversion of reactor neutrons to 15 MeV, via the reaction sequence $^6Li(n,\alpha)T - D(t,n)^4He$, using ^6LiD. An analysis is presented to show that about 2.1 15-MeV neutrons should be produced for every 10^4 thermal neutrons absorbed in ^6LiD. Values obtained experimentally were 0.21 for $^6LiOD \cdot D_2O$, 1.1 for LiD and 1.7 for ^6LiD. Computations and measurements of dose rates and facility parameters are presented for four biomedically useful facilities. ^6LiD converters are suggested for biomedical irradiations, radiodiagnostic nuclide production, fast neutron activation analyses and biomedical neutron radiography, as well as for non-biomedical uses. (auth)

Reactor Components, Fuels, and Accessories

Refer also to abstracts 20204, 20206, 20228, 20241–20243, 20261–20263, 20307–20311, and 21865.

21893 (AAEC/LIB/Bib-365) ELECTRIC HEATERS FOR REACTOR LOOPS. A Bibliography. Geue, P. J. (comp.) (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Sep 1972. 33p. Dep. NTIS (U. S. Sales Only).

One hundred and sixty five references covering the period 1962 to Aug 1972 (INIS, NSA, STAR) are listed chronologically by year and alphabetically by author within each year. Reference is made to an abstract for each item. (MRM)

21894 (FEI-286) ECONOMIC CRITERIA OF EFFICIENCY OF UTILIZATION OF NUCLEAR FUEL IN REACTORS. Orlov, V. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1971. 18p. (In Russian). Dep. NTIS (U. S. Sales Only).

Beginning with a picture of limited reserves of cheap uranium, the price of U, and the associated price of Pu, were determined. These data were utilized to formulate economic criteria for the optimization of reactors and to arrive at several quantitative estimates for dollars/kW for fast breeders, fast converters, and light water reactors. (tr-auth)

21895 (KFK-1701) SYSTEMATIC ERRORS AND CORRECTION POSSIBILITIES IN INVERSE KINETIC CONTROL ROD CALIBRATIONS. Walze, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Systemtechnik und Reaktorphysik). Nov 1972. 76p. (In German). Dep. NTIS (U. S. Sales Only).

A survey is presented of the most important systematic errors which appear when reactor shim rods are calibrated by means of the continuous run method. Possible corrections are described. Rod calibrations at the fast zero power critical facility SNEAK (Schnelle Null-Energie-Anordnung Karlsruhe) serve as examples. The influences of the integrating time interval, the measuring techniques, the additional neutron source, the reactor kinetic parameters and the delayed gamma flux are either negligible or can be corrected easily. Up to now this was not true for the large errors according to space-dependent higher harmonics of the neutron flux distribution. This kind of systematic error was a big disadvantage of the continuous run method compared with the more conventional stable period measurement, because there were only correction procedures for stepwise reactivity changes. A new iterative method is described, which can also be applied to slow, that is, not stepwise reactivity changes as they appear when a shim rod is calibrated continuously. For rod calibration at SNEAK, this method gave satisfying results. (auth)

21896 (ORNL-TM-4128) NEUTRON CAPTURE IN REACTOR STRUCTURAL MATERIALS. Macklin, R. L. (Oak Ridge National Lab., Tenn). Feb 1973. Contract W-7405-eng-26. 13p. Dep. NTIS.

A brief review is given of the capture and transmission programs at ORELA, listing resident and visiting personnel and nuclides being emphasized in early 1973. Comments on capture cross section analysis and data reduction and a critical survey of capture detectors are included. (1 figure) (auth)

21897 (TIM-808) FUEL CENTERLINE TEMPERATURES. Killen, R. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 24 Feb 1964. 12p. Dep. NTIS.

Declassified 20 Oct 1971.

A detailed method for determining the centerline temperature of a reactor fuel element is presented. (JWR)

21898 CALCULATIONS OF CADMIUM CUTOFF ENERGIES. Kocic, Antanasije (Boris Kidric Inst. of Nuclear Science, Belgrade). Nucl. Sci. Eng.; 49: No. 3, 387-9(Nov 1972).

The integral forms for the effective cadmium cutoff energy are developed for different geometrical configurations such as: (a) infinite slab, (b) infinite cylinder, and (c) infinite slab absorber and infinite cylindrical cadmium filter. (auth)

21899 ANGULAR DISTRIBUTION OF THERMAL NEUTRONS AT THE SURFACES OF BLACK AND GREY CYLINDERS. Doutriaux, D. G.; Andrews, D. G. (Univ. of Toronto). Nucl. Sci. Eng.; 49: No. 3, 301-9(Nov 1972).

Angular distributions of thermal neutrons at the surfaces of cadmium and copper cylinders were measured by activating directionally sensitive detectors. Comparisons of the experimental data with the theoretical predictions of the distributions were made by the "optical path method," using a radial flux distribution either calculated with the THERMOS code or measured. Experimental points agree within ±3% with the predicted values given by the measured fine structure, corrected for the shadowing effect due to the collimator, and are about 10% lower than the values predicted by the THERMOS radial flux. The results give some information on the analytical form of the angular flux in the different regions of observation. (auth)

21900 ENERGY RELEASE IN A REACTOR COMPENSATING ROD. Kuznetsov, V. A.; Mogil'ner, A. I.; Koroleva, V. P.; (and others). At. Energ. (USSR); 33: No. 5, 926-8(Nov 1972). (In Russian).

The specific energy release by a boron reactor rod was measured as resulting from the (n,α) reaction on ^{10}B. Modern semiconductor and track detectors were employed in place of the customary indicating layers of ^{10}B and ^{235}U, with excellent agreement between the two types of detectors. An example is given in which the graph of the density distribution of neutron absorption vs the height of a boron carbide rod may be used to evaluate the total energy release in the rod. (KSW)

21901 EXPERIENCE IN THE USE OF A STANDARD COMPUTER INTERFACE FOR LABORATORY AUTOMATION SYSTEMS. Collins, G. B.; Keats, A. B. (United Kindgom Atomic Energy Authority, Winfrith, Eng.). pp 40-6 of Trends in On-Line Computer Control Systems. London; Inst. of Electrical Engineers (1972).

From Conference on trends in on-line computer control systems; Sheffield, England (18 Apr 1972). See CONF-720449.

A standardized method was required for connecting a wide variety of instruments and control equipment to the process control computer used in a reactor instrumentation system. A modular system was designed, on the basis of criteria which are discussed. Experience with this interface system showed certain restrictions, particularly in the possibilities for expanding the original design. It was recognized that any system which uses a computer as a time-shared controller for a number of data collection or distribution terminals can be divided into three parts joined by the "channel interface" and the "device interface." It is stated that considerable progress has been made in the standardization of a device interface and a British Standard has been issued. In connection with attempts being made to standardize a channel interface, a description is given of a European standard called CAMAC, which has been devised by the ESONE organization. (UK)

21902 THERMALIZATION EFFECTS IN THE THEORY OF NEUTRON ABSORBING FOILS. Morsy, S.; Williams, M. M. R. (Queen Mary Coll., London). Atomkernenergie; 20: No. 1, 29-32(Sep 1972).

The problem of flux perturbation due to neutron absorbing foils or control plates is analyzed by examining the complications that arise when the thermalization properties of the moderator are taken into consideration. The convenient form of a synthetic scattering kernel is discussed. An assessment is made of the validity of the one speed approximation. For a given foil, its rate of absorption increases as the thermalization properties of the surrounding moderator become poorer. In going from a very strong thermalizer to a very weak one the flux in the foil increases by about 8%. This indicates that the one speed approximation tends to overestimate absorption in foils and control rods. 5 references. (auth)

21903 DETERMINING THE OPTIMUM NUMBER OF TRANSDUCERS FOR IN-PILE TESTING OF THE NEUTRON FIELD. Potapenko, P. T. Meas. Tech. (USSR) (Engl. Transl.); 15: No. 4, 605-7(Apr 1972).

Translated from Izmer. Tekh.; 15: No. 4, 64-6(Apr 1972).

A mathematical model for the determination of the optimum number and location of transducers for the determination of neutron flux density in a reactor core is discussed. (JWR)

21904 REINFORCED-CONCRETE PRESSURE VESSEL WITH LINING. Meyer, J.; Pfeffer, J. (to Fried Krupp Gesellschaft mit Breschrankeeter Haftung). U. S. Patent 3,712,012. 23 Jan 1973. Priority date 5 Nov 1969, Federal Republic of Germany (F. R. Germany). 8p.

A reinforced-concrete vessel adapted to withstand pressure, e.g., for a pressurized-fluid nuclear reactor, is described which has an inner lining of corrosion-resistant (stainless) steel having vertically or horizontally-running corrugations, the crests of which are supported by steel profiles. (9 claims, 2 drawing figures) (Official Gazette)

21905 NUCLEAR REACTOR VESSEL STRUCTURE. Cahill, W. J. Jr. (to Consolidated Edison Co.). U. S. Patent 3,711,371. 16 Jan 1973. Filed date 6 Jan 1971. 6p.

A nuclear reactor pressure vessel structure is described having an inner vessel containing coolant fluid under pressure and completely encased within an outer vessel, the inner vessel being mounted in spaced relationship with respect to said outer vessel, and fluid under pressure equal to that of said coolant fluid disposed within said spacing between the vessels; fluid passages between said spacing between the vessels and the inside of said inner vessel whereby the fluid within said spacing is said coolant fluid. (Official Gazette)

21906 CONTROL RODS FOR NUCLEAR REACTORS. Bowles, L. F.; Walker, A. (to English Electric Co. Ltd.). British Patent 1,295,283. 8 Nov 1972. Filed date 3 Apr 1969. 7p.

Disadvantages of conventional control rod systems are described, particularly the possibility of the rods jamming in their housings. The control rod system described obviates the latter, and comprises a number of neutron absorbing elements, disposed end-to-end, and held together by a tie-bar extending through the elements and provided at least one end with an end piece engaging a first element. The tie-bar includes between its ends at least one region at which it is broken into two parts when stressed transversely. A second element is provided internally with means for applying a localized transverse force to the foregoing region in the event of the second element being forced transversely relative to the tie-bar, thereby separating the tie-bar at this region. (UK)

21907 CHANGE IN FISSION GAS RELEASE BY KNOCKOUT AS A FUNCTION OF BURNUP. Fleck, Carl M.; Boeck, Helmut; Erber, Helmut; Brunner, Peter. Atomkernenergie; 20: No. 1, 51-4(Sep 1972).

Two release parameters have been defined and the total release of an in-pile facility for fission noble gases was calculated in two models, one of them considering the deposition of fissile material on nearby surfaces, which is knocked out by fission fragments. (auth)

21908 BROAD BAND ACOUSTIC FATIGUE THEORY AS APPLIED TO MULTI-MODAL STRUCTURAL VIBRATIONS. Yeh, L. (General Electric Co. Ltd., Whetstone, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 1, 107-116(Jan 1973).

Structures inside the reactor of a nuclear power station are often required to be designed to a specified life. A technique is described for testing the structures or sections of structures at design stage in an acoustic testing facility. A broad band acoustic fatigue theory may be applied to the measured stresses so that the life of these structures, under broad band acoustic excitation, may be predicted. (auth)

21909 SPHERICAL PARTICLE WITH FISSILE NUCLEUS. Bairiot, H. (to Societe Belge pour l'Industrie Nucleaire). Belgian Patent 779,364. 15 Feb 1972. (In French).

A fuel particle for a nuclear reaction is described, consisting of recovered fertile and fissile materials with an impervious coating and characterized in that the fissile material is surrounded by the fertile material. (tr-auth)

21910 REACTOR CONTROL INCLUDING INDIVIDUAL AND GROUP ROD MOTOR CONTROLS. Rosen, P. J. (to Diamond Power Specialty Corp.). U. S. Patent 3,706,921. 19 Dec 1972. Filed 8 Aug 1968.

A control system is described for controlling the relative position of a plurality of control rods within a nuclear reactor. The control system includes a single rod control subsystem for controlling the motion of the individual rods within the nuclear material and a group control subsystem for controlling a plurality of rods of a group. The system includes a circuit for precluding any single rods or group of rods from being actuated in a direction opposite to that commanded to achieve synchronism of that particular rod. Thus, the rods moving from a first position to a second position, a reference position is established which is the average of the position of all the rods and the only rods which will move to position 2 will be those which deviate further from position 2 than the reference level. The system also includes a fault detection system. (8 claims, 15 drawing figures) (auth)

21911 STRUCTURAL MECHANICS IN REACTOR TECHNOLOGY. SAFEGUARD ENGINEERING. First International Conference, Berlin, Germany, September 20–24, 1971. Nucl. Eng. Des.; 19: No. 2, 207-408(1972). (In German and English). (CONF-710903-(Vol.19,No.2)).

Eight papers were presented. A separate abstract was prepared for each paper. (LCL)

For abstracts of individual papers see: 19774, 21578, 21605, 21606, 21638–21640, and 21849.

21912 APPLICATION OF CADMIUM COMPOUNDS AS A BURNABLE POISON IN NUCLEAR REACTORS. Hattenbach, K.; Melkonian, G. A.; Baur, E. (to Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH). German Patent 1,764,164. 17 Feb 1972. (In German).

The claim deals with the application of a spinel-like mixed oxide, composed of cadmium and an additional metal according to the formula $Me(I)Me_2(II)O_4$ using cadmium aluminate ($CdAl_2O_4$) or cadmium zirconate (Cd_2ZrO_4) as a burnable poison. (GF)

Reactor Physics and Core Engineering

21913 (ITEF–860) PROBLEM ON THE NUCLEAR REACTOR POWER MINIMUM. Zaritskaya, T. S.; Petrov, Yu. V.; Rudik, A. P.; Sakhnovskii, E. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki. Akademiya Nauk SSSR, Leningrad. Fiziko-Tekhnicheskii Institut). 1971. 44p. (In Russian). INIS.

Physics

Refer also to abstracts 21007, 21009, 21027, 21039, and 21884.

21914 (AD–747526) PERTURBATION ANALYSIS OF NONLINEAR REACTOR KINETICS WITH DOPPLER FEEDBACK. Nemeth, E. P. (Naval Postgraduate School, Monterey, Calif.). Jun 1972. 109p. NTIS.

Thesis.

The analysis of nonlinear reactor kinetics with Doppler feedback is developed by the use of the Poincáre-Lindstedt perturbation technique. The two types of temperature dependent reactivity coefficients to be investigated are dk/dT proportional to 1/T and dk/dT proportional to 1/(T to the 3/2 power). Each of these reactivity models are analyzed for the reactor with positive and negative coefficients of reactivity and infinite slab and finite cylindrical geometries. The Poincáre-Lindstedt perturbation solution is constructed in the form of an expansion about the unperturbed state of the reactor. Each of the perturbed equilibrium solutions is subsequently analyzed for stability. (auth)

21915 (IAE–2136) CALCULATION OF MULTIGROUP HETEROGENEOUS CONSTANTS FOR A THICK ROD FROM ITS ALBEDO CHARACTERISTICS. Gorodkov, S. S. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 16p. (In Russian). INIS.

A real rod with given albedo characteristics may be replaced with a hypothetical one of the material of the surrounding moderator with singular sources at the axis. This is based on an interpretation of free coefficients in an analytical solution of a system of multigroup diffusion equations. The power of these sources are linearly dependent on the fluxes produced at the axis of such a rod by external sources. A computation of the matrix representing this dependence was conducted in a 26-group approximation. (tr-auth)

21916 (IAE–2138) SENSITIVITY OF THE THERMAL UTILIZATION COEFFICIENT TO THE VARIATIONS IN MACROSCOPIC CROSS SECTIONS. Laletin, N. I. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 16p. (In Russian). INIS.

The sensitivity of the thermal utilization coefficient to variations in macroscopic cross sections was evaluated for an element in a heterogeneous reactor. Simple formulas which permit estimates to be made for a broad class of elements were obtained using a single-velocity approximation. (tr-auth)

21917 (IAE-2141) PROGRAMS FOR A MULTIGROUP MONTE CARLO CALCULATION OF REACTORS AND REACTOR CELLS. PART 2. Frank-Kamenetskii, A. D. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 32p. (In Russian). INIS.

21918 (IAE-2148) PROGRAMS FOR MULTIGROUP COMPUTATION OF REACTORS AND CELLS BY THE MONTE-CARLO METHOD. PART 1. Frank-Kamenetskii, A. D. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 24p. (In Russian). INIS.

21919 (UJV-2894-R) LOCAL HETEROGENEOUS CALCULATION FOR A REACTOR. Lelek, V. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). 1972. 10p. (In Russian). Dep. NTIS (U. S. Sales Only).

A method of local calculation for a reactor is described. Heterogeneous Galanin equations were solved only within the given area (sufficiently large with respect to the length of the diffusion path and moderation). The influence of the surrounding medium was considered by means of dummy neutron sources. The method proved to be quite effective and sufficiently accurate. (tr-auth)

21920 APPLICATION OF INVARIANT EMBEDDING TO REACTOR PHYSICS. Shimizu, A.; Aoki, K. Nuclear Science and Technology. A Series of Monographs and Textbooks, No. 9. New York; Academic Press, Inc. (1972). 191p. $13.50.

The application of the method of invariant embedding to radiation shielding calculations and to criticality calculations for reactors is studied. Part A deals with the reflection and transmission of gamma rays by slabs. Part B covers applications to criticality calculations. Extensive references are provided for both sections. (JWR)

21921 MINIMUM CRITICAL MASS IN INTERMEDIATE REACTORS SUBJECT TO CONSTRAINTS ON POWER DENSITY AND FUEL ENRICHMENT. Goldschmidt, P. (Electrobel, S. A., Brussels). Nucl. Sci. Eng.; 49: No. 3, 263-73(Nov 1972).

Pontryagin's Maximum Principle and Robbins' Criterion allow us to find, in the general case of intermediate reactors, the distribution of fuel enrichment that minimizes the critical mass of a reactor of given power and subject to constraints on the maximum power density and on the enrichment. The two group diffusion model is used in slab geometry. The optimal sequence of control (enrichment) zones is made up of a central constant power density zone, a zone of maximum enrichment, a zone of variable enrichment (where the control is singular) and finally an external zone of minimum enrichment (or a reflector). In the particular case of fast reactors the optimal solution does not include the singular control zone. (auth)

21922 OPTIMUM BINARY SIGNALS FOR REACTOR FREQUENCY RESPONSE MEASUREMENTS. Buckner, M. R. (Savannah River Lab., Aiken, S. C.); Kerlin, T. W. Nucl. Sci. Eng.; 49: No. 3, 255-62(Nov 1972).

A two-level input signal called the multifrequency binary signal (MFBS) was evaluated for use in nuclear reactor frequency response measurements and was employed in tests on the Molten Salt Reactor Experiment. The MFBS was found to have significant advantages over other currently used signals in terms of test duration required to achieve necessary accuracy. (auth)

21923 VARIATIONAL ESTIMATES AND GENERALIZED PERTURBATION THEORY FOR THE RATIOS OF LINEAR AND BILINEAR FUNCTIONALS. Stacey, Weston M. Jr. (Argonne National Lab., Ill.). J. Math. Phys. (N. Y.); 13: No. 8, 1119-25(Aug 1972).

Variational functionals are presented which provide an estimate of ratios of linear and bilinear functionals of the solutions of the direct and adjoint equations (inhomogeneous and homogeneous) governing linear systems. These variational functionals are used as the basis for a generalized perturbation theory for estimating the effects of changes in system parameters upon these ratios of linear and bilinear functionals. The relation of the present theory to the variational theory of Pomraning and to the generalized perturbation theory of Usachev and Gandini is discussed. Potential applications of the theory to nuclear reactor physics are outlined. 18 references. (auth)

21924 TWO-GROUP CRITICAL PROBLEMS FOR SLABS AND SPHERES IN NEUTRON-TRANSPORT THEORY. Kriese, J. T.; Siewert, C. E.; Yener, Y. (North Carolina State Univ., Raleigh). Nucl. Sci. Eng.; 50: No. 1, 3-9(Jan 1973).

The elementary solutions of the two-group neutron-transport equation are used to solve critical problems for finite slabs and spheres. The half-range orthogonality properties of the basic eigenvectors are used, along with the fundamental H-matrix, to reduce the encountered system of singular integral equations to a system of Fredholm-type equations, and these final equations are solved iteratively to yield accurate predictions of the two-group values of the extrapolated endpoint and critical dimensions for a selected set of slabs and spheres. (auth)

21925 REPLY TO COMMENTS ON THE CONCEPT OF MULTIPLE-INPUT ZERO POWER DESCRIBING FUNCTIONS IN NUCLEAR REACTORS. Akcasu, A. Z.; Bost, M. (Univ. of Michigan, Ann Arbor). Nucl. Sci. Eng.; 49: No. 3, 407-8(Nov 1972).

21926 COMMENTS ON THE CONCEPT OF MULTIPLE-INPUT ZERO POWER DESCRIBING FUNCTIONS IN NUCLEAR REACTORS. Tan, Sevim. Nucl. Sci. Eng.; 49: No. 3, 405-7 (Nov 1972).

21927 TREATMENT OF BOUNDARY VALUE PROBLEMS IN OPTICALLY THICK MEDIA BY MEANS OF LIE SERIES. Auerbach, T.; Haelg, W.; Mennig, J. (Technische Hochschule, Zurich). Nucl. Sci. Eng.; 49: No. 3, 384-7(Nov 1972).

Two suggestions are put forward for avoiding numerical difficulties encountered in the treatment of optically thick media by analytical methods such as Lie series. One is the usual procedure of subdividing a single zone into several subzones. The use of Lie series in connection with this formalism is described. The second method allows a coarser subdivision of a given zone but is restricted to plane geometry. (auth)

21928 TRANSVERSE DIFFUSION COEFFICIENT IN A SQUARE LATTICE. Auerbach, T.; Haelg, W.; Mennig, J. (Eidgenoessische Technische Hochschule, Zurich). Nucl. Sci. Eng.; 49: No. 4, 509-15(Dec 1972).

The transverse diffusion coefficient is calculated by integrating the current derived from heterogeneous multigroup dipole theory in a finite, square system, along two opposite sides of the square cell. Use of response coefficients allows the result to be presented in relatively simple form, regardless of fuel element complexity. Subsequently, the buckling dependence is eliminated from the diffusion coefficient, or reduced to lowest order, making it consistent with the low order approximation represented by dipole theory. Results are compared with other methods and a numerical example is given. (auth)

21929 TIMING COMPARISON STUDY FOR SOME HIGH ORDER FINITE ELEMENT APPROXIMATION PROCEDURES AND A LOW ORDER FINITE DIFFERENCE APPROXIMATION PROCEDURE FOR THE NUMERICAL SOLUTION OF THE MULTIGROUP NEUTRON DIFFUSION EQUATION. Kaper, Hans G.; Leaf, Gary K.; Lindeman, Arthur J. (Argonne National Lab., Ill.). Nucl. Sci. Eng.; 49: No. 1, 27-48(Sep 1972).

The results of detailed comparison studies of the efficiency of high order finite element approximations vs low order finite difference approximations for the numerical solution of the static multigroup diffusion equation in two dimensions are presented. The comparisons are based on the execution times for a k_{eff} calculation with a prescribed precision for two particular computer programs—HOD (finite elements) and DARC2D (finite differences). The calculations were performed for three different types of reactor configurations: a simple two-zone configuration with two energy groups, a multizone configuration [1000-MW(e) LMFBR mockup] with four energy groups, and a loosely coupled configuration with two energy groups. (auth)

21930 LINEAR STABILITY OF FAST AND THERMAL REACTOR MODELS USING SPACE-TIME KINETICS. Solomon, Kenneth Alvin; Kastenberg, William E. (Univ. of California, Los Angeles). Nucl. Sci. Eng.; 49: No. 1, 99-108(Sep 1972).

A method based on the Rayleigh-Ritz or Galerkin technique is presented for obtaining domains of linear stability in terms of the parameter space for space-dependent reactor dynamics models. The method developed is computationally economical because previous calculations are retained as the order of approximation increases. In addition, the method reduces to finding the eigenvalues of a matrix so any standard procedure can be used. The method is applied to data typical of a fast and a thermal reactor with fuel and coolant feedback. One group of delayed neutrons is also included. (auth)

21931 APPLICATION OF EIGENFUNCTION EXPANSIONS TO PROBLEMS IN NONLINEAR SPACE-TIME REACTOR DYNAMICS. Rumble III, Edmund T.; Kastenberg, William E. (Univ. of California, Los Angeles). Nucl. Sci. Eng.; 49: No. 2, 172-87(Oct 1972).

Several nonlinear space-time reactor models are studied by employing modal analysis. Eigenfunction modes resulting from the solution of Sturm–Liouville equations satisfying the appropriate linear portion of the neutron diffusion equation are chosen. These modes form a complete, orthogonal set and are convenient to calculate numerically. Examples where coefficients and time constants are representative of present reactor design are studied. The work is focused on space-dependent feedback and local step and ramp reactivity insertions. The large difference in the neutronic and thermal-hydraulic time constants gives rise to computational difficulties. This difficulty, characteristic of "stiff systems," was minimized by use of a rational extrapolation technique to solve the resultant equations. (auth)

21932 PARTIAL NEUTRON WAVES IN A REFLECTED REACTOR. Shani, Gad (Univ. of the Negev, Beer-Sheva, Israel). Atomkernenergie; 20: No. 1, 89(Sep 1972).

A two-group calculation of neutron wave propagation in a reflected reactor is presented. (JWR)

21933 APPLICATION OF POLARITY CORRELATION METHOD TO GRAPHITE MODERATED REACTOR. Yasuda, Hideshi (Japan Atomic Energy Research Inst., Tokai); Miyoshi, Ryo. J. Nucl. Sci. Technol. (Tokyo); 9: No. 9, 544-50(Sep 1972).

The polarity correlation method has been applied to an experiment for measuring the prompt mode neutron decay constant of a reactor with a long neutron lifetime. Measurements have been performed in the SHE VIII-1 at critical and several subcritical steady states (0 ~ – $1). The analog signal of detector output is converted to a polarity signal having only one-bit of information on the amplitude of the detected signal. The polarity correlation function is obtained as the correlation function between two polarity signals. Attention has been paid in the design of the correlator to obtain ample stability in operation. Using a digital computer, the prompt mode neutron decay constant is determined with 2% experimental accuracy from the decay curve of the polarity correlation function. A series of the prompt mode neutron decay constants is fitted to an approximated expression of inhour equation to obtain β/l. The value of each prompt mode neutron decay constant was found to be in good agreement with that measured by the pulsed neutron technique. The polarity correlation method is particularly applicable to critical or near critical state where a pulsed neutron source cannot be effectively introduced. An estimation is made for the error in the measured polarity correlation function due to unbalanced mean setting level in the experiment. (auth)

21934 SOME REMARKS ON THE ENDOGENEOUS PULSED SOURCE TECHNIQUE IN REACTOR NOISE ANALYSIS. Yasuda, Hideshi (Japan Atomic Energy Research Inst., Tokai); Miyoshi, Ryo. J. Nucl. Sci. Technol. (Tokyo); 9: No. 8, 501-3(Aug 1972).

The analog flash start technique was studied analytically in reference to the Gaussian distribution model for fluctuations as well as to the concept of the giant neutron chain family. A highly refined method, the conditional polarity technique, is proposed as a result of the analysis. (JWR)

21935 OPTIMAL CONTROL OF ^{135}Xe OPERATIONAL TRANSIENTS IN THERMAL REACTORS. I. Vukovic, Danica (Nuclear Power Plant Dept., Belgrade). Atomkernenergie; 20: No. 1, 37-40(Sep 1972).

The problem of Xe 135 transient control in thermal reactors under operation is formulated and solved by applying Pontryagin theorem of optimal processes. The optimization criterion adopted is the minimal transition time between the two power levels (Time Optimal Method). This formulation resulted in a computing model that can be used to define the control rods strategy. An application of this formalism to a three-dimensional reactor model is presented. 8 references. (auth)

21936 REMARKS ON THE TRANSFER FUNCTION RELATING INLET TEMPERATURE FLUCTUATIONS TO NEUTRON NOISE. Kosaly, G.; Mesko, L. (Central Research Inst. for Physics, Budapest). Atomkernenergie; 20: No. 1, 33-6(Sep 1972).

The reactor response to inlet temperature fluctuations has been studied via the axial dependent two region model of heat transfer and the point model of neutron noise. It is shown that a peak which was predicted in the literature does not exist. The sink structure of the transfer function is examined in detail. 8 references. (auth)

21937 SPACE DEPENDENT NEUTRON AND GAMMA REACTOR NOISE ANALYSIS INCLUDING THE EFFECTS OF DELAYED NEUTRONS. Kostic, Lj. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Atomkernenergie; 20: No. 1, 41-6(Sep 1972).

The space dependent spectral density functions of the stochastic fluctuations of the neutron and gamma flux in a homogeneous infinite multiplying medium at zero power are developed in the frequency domain including the effects of delayed neutrons. The Langevin technique was used to obtain these functions between two space points in the medium. For this purpose, the so-called Green's functions of the neutron and gamma flux, including delayed neutrons, have been introduced as frequency responses to the injection of a thermal neutron into the system. The treatment is based on the one group energy diffusion model. Applying the developed theoretical model to an infinite light-water-U 235 system the effects of delayed neutrons upon the spatial correlation ranges of neutrons and gammas have been demonstrated. 5 references. (auth)

21938 RIGOROUS DIFFUSION MODEL FOR CELL HOMOGENIZATION. Bonalumi, R. (CISE, Milan). Energ. Nucl. (Milan); 20: No. 1, 39-43(Jan 1973).

An entirely new approach is presented that allows a rigorous calculation of non-uniform reactor systems by using a diffusion theory formalism on homogenized cells. Each cell is characterized by two sets of homogenized parameters: the usual, cell-edge normalized constants for the self-generated flux, and new response constants, independent of sources in the cell and related to the reaction of the cell to the environment. 4 references. (auth)

21939 ANALYTICAL TREATMENT OF THE FLAT THERMAL FLUX FOR THE PLANE GEOMETRICAL CASE. Sahin, S. (Institut fuer Kernenergetik, Stuttgart). Atomkernenergie; 20: No. 2, 117-21(Oct 1972). (In German).

Starting from the mathematical treatment of Goertzel a fuel distribution function for flat thermal flux in two group diffusion theory for the plane geometrical case is obtained analytically. As the mathematical treatment is subject to a number of restrictions, this function is used only for the first step in an iterative solution. 6 references. (auth)

21940 VARIABLE REFERENCE NEUTRON TEMPERATURE FOR EVALUATING THE THERMAL SPECTRUM IN CHEMICALLY BOUND MODERATORS. Elmeshad, Y. (Alexandria Univ., Egypt); Elmofty, O.; Elsayed, M. N. Atomkernenergie; 20: No. 1, 47-50 (Sep 1972).

In the effective neutron temperature method the thermal spectrum is assumed to have a Maxwellian distribution which shifts along the energy scale for varying degrees of absorption. It is proposed to introduce a velocity dependence to the value of the neutron temperature, so that for calculating the neutron spectrum at a certain velocity we have to refer to a corresponding neutron temperature. The proposed method is based on expanding the exact spectrum distribution about a Maxwellian one. First order approximation for this expansion is then used for evaluating the required distribution. The method is applied to determine the thermal spectrum in chemically bound moderator systems using Brown and St. John Model. 7 references. (auth)

21941 CORRELATING THE RATIO OF THE PEAK-TO-AVERAGE POWER IN A REACTOR WITH QUADRANT POWER DISTRIBUTIONS. Levine, M. M. (Brookhaven National Lab., Upton, NY). Nucl. Sci. Eng.; 50: No. 2, 176-179(Feb 1973).

A prescription is presented for obtaining a correlation from which an estimate can be made of the ratio of the peak-to-average power in a nuclear reactor. The correlation is obtained from the power generated in each quadrant of the reactor core. (auth)

21942 EFFECT OF DELAYED-NEUTRON MODE ON THE DETERMINATION OF THE PROMPT-NEUTRON DECAY CONSTANT IN PULSED-NEUTRON MEASUREMENTS. Kaneko, Y.; Ohkubo, S.; Akino, F. (Japan Atomic Energy Research Inst., Tokai). Nucl. Sci. Eng.; 50: No. 2, 173-176(Feb 1973).

An improved data processing method is developed for pulsed-neutron measurements in a multiplying medium. The characteristic feature of the method is to determine the value of the prompt-neutron decay constant α as accurately as possible by removing the delayed-neutron decay component from the raw experimental data. The delayed-neutron decay component is estimated to be the deviation of the response of a one-point reactor from a single exponential decay for repeated pulsed-neutron bursts. It is obtained by taking account of the first and second post-neutron bursts. From the application of the method to some test data provided by calculation and to experimental data from pulsed-neutron experiments in the Semi-Homogeneous Experiment it is found that the usual data processing method, disregarding the slowly decaying delayed-neutron mode, should underestimate the value of α by ~4% in a near-critical multiplying medium having a neutron lifetime of ~1 msec. (auth)

21943 INTEGRAL FORMULATION OF THE NEUTRONS SCATTERING MOMENTS FOR MONATOMIC GASES. Kuehn III, N. H.; Murray, R. L. (North Carolina State Univ., Raleigh). Nucl. Sci. Eng.; 50: No. 2, 164-169(Feb 1973).

A development in convenient matrix representation is given for the first four moments of the neutron scattering kernel $K(v,v')$, for a monatomic Maxwellian gas with arbitrary dependence of the scattering cross section on relative speed. The availability of explicit forms for $\sigma_s^n(x,x')$, components of the moments in terms of dimensionless speeds, for n = 0, 1, 2, and 3, as single-integral expressions facilitates the spherical harmonics solution of neutron thermalization problems through the P_3-approximation. (auth)

21944 HIGHER FLUX MODE EFFECTS IN XENON SPATIAL OSCILLATIONS. Rydin, R. A. (Univ. of Virginia, Charlottesville). Nucl. Sci. Eng.; 50: No. 2, 147-152(Feb 1973).

The stability of a reactor to xenon-induced spatial power oscillations is generally determined using the first harmonic flux mode alone. This assumption has been tested by including the second harmonic mode in the model and allowing cross coupling between modes. It was found that modal interaction effects are only significant for unstable situations, thus verifying that the use of a single flux mode stability criterion is an adequate approximation to the multimode case. (auth)

21945 SPHERICAL HARMONICS TREATMENT OF EPITHERMAL NEUTRON SPECTRA IN REACTOR LATTICES. Matausek, M. V. (Boris Kidric Inst. of Nuclear Science, Belgrade). Nucl. Sci. Eng.; 49: No. 1, 49-58(Sep 1972).

A procedure has been developed to solve the slowing down transport equation for neutrons in a cylindricalized reactor lattice cell. Treating the anisotropy of the epithermal neutron flux by the spherical harmonics formalism, which reduces the space-angle-lethargy-dependent transport equation to the matrix integrodifferential equation in space and lethargy, and replacing the lethargy transfer integrals by finite-difference forms, a set of matrix ordinary differential equations, with lethargy and space dependent coefficients, is obtained. In the resonance region this set takes a lower block triangular form and can be directly solved by forward block substitution; in the lethargy range, where the fast fission effects have to be considered, the iterative procedure is introduced. A simple and efficient approximation is then proposed, making possible the analytical solution for the spatial dependence of the spherical harmonics flux moments. The proposed procedure has been numerically examined and approved. Some typical results are presented and discussed. (auth)

21946 REACTOR DEPLETION ANALYZED AS A SPACE-TIME PROBLEM. Westlake, W. J. Jr.; Henry, A. F. (Massachusetts Inst. of Tech., Cambridge). Nucl. Sci. Eng.; 49: No. 4, 482-8(Dec 1972).

A method is proposed for treating depletion effects in a nuclear reactor by a mathematical model in which the time derivative of the neutron flux is retained and the reactor is kept at its desired power level through operation of a control system actuated by any differences between the actual and desired power level. The criticality searches required with the conventional depletion method to find consistent density-temperature profiles, control rod positions, xenon distribution, and flux shapes are thereby avoided. The time-dependent flux, control, and isotopic concentration equations are linearized and solved simultaneously by a numerical procedure that permits time steps as large as those employed with conventional depletion codes. Simple numerical examples that test the essential features of the method are presented. (auth)

21947 SPACE- AND TIME-DEPENDENT ANALYSIS OF SUBCRITICAL TRANSIENTS IN A HEAVY WATER REACTOR. Foltman II, Anthony Joseph. Atlanta; Georgia Inst. of Tech. (1972). 185p. University Microfilms Order No. 72-26,309.

Thesis.

Experimental verification of two-group, two-dimensional kinetics calculational methods was attempted. One method of interest was finite-differenced diffusion theory typical of the schemes used as standards. The second method involved the adiabatic approximation, in which the spatial information is supplied by static flux shapes corresponding to reactor configurations during the transient. Such methods generally are less accurate due to approximation of delayed neutron contributions. Several experiments were performed using computerized data acquisition to sample thermal neutron flux levels at various core locations 200 times per second. The comparisons of statics calculations with the experimental results illustrated good agreement for general spatial features. For positions within the core, the greatest difference noted was about 25 percent. The reflector regions exhibited differences greater than 50 percent for certain control rod positions. This deviation was concluded to be due to the inadequacy of diffusion theory in regions with large flux gradients. As with the statics results, the kinetics simulations using the standard model illustrated good agreement for spatially dependent effects. For the insertions longer than one second, the differences noted could be directly attributed to the differences observed in the statics results. Significantly larger differences between the standard model's calculations and experimental data resulted for the faster insertions. It was therefore concluded that insertions slower than one second do not require stringent statics modeling if the adequacy of the statics model is known. For fast insertions, typical of operational transients in a power reactor, however, the model must calculate the actual flux shape and eigenvalue within a few percent for the standard methods to be accurate. This is especially true if the rapidly changing portion of the transient is under consideration. The results of the adiabatic model calculations exhibited the expected delayed neutron holdback, but also a 50 percent savings in computation time. For insertions as fast as one second, the method lagged the standard model calculations by about 40 percent during the prompt drop. If the asymptotic portion of a fast transient is of primary importance, the adiabatic method is as accurate as the standard methods. Simulations of insertions faster than one second exhibited large error, and consequently the need for accurate representations of delayed neutrons. (Diss. Abstr. Int., B)

21948 APPLICATIONS OF SPACE ENERGY SYNTHESIS TO FAST REACTOR SYSTEMS. Savio, R. P. Lafayette, IN; Purdue Univ. (1972). 178p. University Microfilms Order No. 72-30,973.

Thesis.

Space energy synthesis of multigroup diffusion theory has been improved by the further development of the Kerr and kernel methods of iterative and successive synthesis. Here work has been performed in three major areas: (1) The iterative and successive convergence of the Kerr and kernel techniques has been studied. (2) Techniques of mode selection have been developed for the kernel method. (3) The Kerr and kernel techniques have been applied to fast reactor problems. The conclusions drawn were: (1) The convergence of the kernel technique is satisfactory for practical application to typical fast reactor problems. Good convergence was not achieved with the Kerr technique. (2) Mode selection methods for the kernel method based largely on physical insight into the nature of the reactor system were sufficient for the construction of accurate synthesis approximations for the problems studied. (3) The kernel method was successfully applied to practical fast reactor problems and was judged to be suitable for the majority of reactor calculations, including parameter studies requiring a high degree of accuracy. The iterative convergence of the Kerr technique was not good enough for parameter studies. In addition applications of exact perturbation theory to the calculation of reactivity differences with space energy calculations were developed and tested. It was concluded that this method led to a definite increase in the accuracy of the calculation. Anomalous calculations, i.e., those in which weight functions which a priori would be expected to give good results gave instead very poor results when compared to diffusion theory results, were also studied. A criterion was developed which was useful in predicting the occurrence of the anomalous calculations. (Diss. Abstr. Int., B)

21949 OPTIMIZATION OF CONTROL ROD PROGRAMMING AND LOADING PATTERN IN MULTIREGION NUCLEAR REACTOR BY THE METHOD OF APPROXIMATION PROGRAMMING. Motoda, H. (Hitachi, Ltd., Kawasaki, Japan). Nucl. Sci. Eng.; 49: No. 4, 515-24(Dec 1972).

A nonlinear programming technique was applied to a one-dimensional multiregion slab reactor to optimize control rod programming and fuel loading pattern simultaneously. Original equations and constraints which were continuous in space and time were discretized and further linearized to use linear programming repeatedly. Numerical results were confirmed by the previously developed two-region burnup space theory. Furthermore, the more quantitative evaluation of burnup optimization and the determination of more realistic control rod programming became possible by the increased degree of control freedom. (auth)

21950 APPLICATION OF A STOCHASTIC GENERATOR TO DETERMINE THE KINETIC RESPONSE OF A NEUTRONIC SYSTEM WITH RANDOMLY FLUCTUATING PARAMETERS. Smith, P. R.; Williams, M. M. R. (Queen Mary Coll., London). J. Nucl. Energy; 26: No. 11, 525-36(Nov 1972).

A stochastic generator was developed which produces a Gaussian random noise with any prescribed power spectral density. The computer programs which form the basis of this generator

were extensively tested for a number of different power spectral densities and found to reproduce the statistical properties with some accuracy. The generator was used to test the analytical solution for the autocovariance function arising from the noise generated by a plane source, fluctuating in intensity, situated in a moderating medium of infinite extent. The spatial dependence of the covariance and autocovariance functions for the analytical and directly simulated solutions are shown to be in close agreement. The stochastic generator is offered as a controlled source of noise which may be used in reactor situations of practical importance where no analytical results are available. (auth)

21951 EFFECT OF MEASURING CAVITY ON INTEGRAL DATA IN A FAST MULTIPLYING SYSTEM. Kuroi, Hideo; Ichimori, Toshihiro; Hirota, Jitsuya (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 9: No. 9, 555-7(Sep 1972).

The effects of the presence of a hole for measuring instruments on reactivity worths and reaction rate ratios in a fast reactor were studied. (JWR)

21952 DETERMINATION OF THE NEUTRON SPECTRUM IN THE THERMAL ENERGY REGION. Borchardt, G.; Meixner, Chr. (Kernforschungsanlage, Juelich, Ger.). Atomkernenergie; 20: No. 2, 102-4(Oct 1972). (In German).

A method for the calculation of the neutron temperature on the basis of the activity ratio of ^{182}Ta to ^{183}Ta is presented. The method is simple in its application but restricted to high neutron fluxes and neutron fluences. For the demonstration of its applicability the neutron temperature in a light water and a heavy water moderated reactor is determined. (auth)

21953 MULTIPLICATION EFFECT ON NEUTRON WAVES. Shani, Gad (Univ. of the Negev, Beer-Sheva, Israel). J. Nucl. Sci. Technol. (Tokyo); 9: No. 9, 564-5(Sep 1972).

Two-group diffusion calculations were performed to study the multiplication effect on neutron waves passing through a nonmultiplying medium into a highly supercritical medium. Experimental measurements were made for a slab core with a neutron wave source on one side and an infinite reflector on the other. The calculated and experimental results were compared. (JWR)

21954 CALCULATION OF PROMPT NEUTRON LIFE TIME (l) AND GENERATION TIME (Λ) FOR FAST SYSTEM BY MONTE CARLO METHOD. Navalkar, M. P.; Subbukutty, K.; Iyengar, S. B. D. (Bhabha Atomic Research Centre, Trombay, India). Atomkernenergie; 20: No. 2, 161(Oct 1972).

Monte Carlo calculations for the prompt neutron lifetime and generation time in a fast system were performed. The results were compared with previously measured values for a Jezebel fast system. (JWR)

21955 EXTENSION AND OPTIMIZATION OF THE SANDWICH TECHNIQUE FOR THE DETERMINATION OF EPITHERMAL SPECTRA IN FAST REACTORS. Truong-Ming-Hung. Liege; Liege Univ. (1972). 133p. (In French).

The development and the optimization of the resonant sandwich technique for the determination of the epithermal components of fast spectra were studied. The theoretical bases of the method are reviewed. The problem of the calculation of the effective resonance integral is shown and the relations leading to the evaluation of the range of error to be applied to the neutron flux extracted are expressed. A detailed description is given of the methods of interpretation, particularly the calculation programs TRIX, PUVW, and Frans. The experimental study includes an assembly of irradiations in the reference spectrum and in the spectrum to be studied of foils of ^{197}Au, ^{115}In, ^{63}Cu, ^{98}Mo, and ^{186}W. (tr-auth)

21956 TECHNICAL ASPECT OF FAST REACTOR FEEDBACK EFFECTS CALCULATION. PART I. TEMPERATURE EFFECTS. Pfann, Jaroslav; Dusek, Josef (Nuclear Research Inst., Rez, Czech.). Jad. Energ.; 19: No. 1, 2-10(Jan 1973). (In Czech).

The method of fast reactor temperature feedback effects calculation is discussed. Expressions for reactivity feedback calculation for an accurate model of active core deformation under the conditions of unequal temperature distribution are presented, supposing the basic reactivity coefficients have been already computed. Particular interest is turned to the reactivity contribution which results from the fuel elements bending caused by non-uniform heat source distribution and hydrodynamic effects. Generally derived expressions are adapted for some conditions which can be often met. The formula for reactivity change due to the fuel element bending is valid even for intense perturbation of power level or coolant flow, presuming sufficiently slow processes. (auth)

21957 THERMAL NEUTRON SPECTRA IN LIGHT WATER POISONED WITH CADMIUM AND/OR INDIUM. Akino, F.; Kaneko, Y.; Kurokawa, R.; Kitadate, K. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Sci. Technol. (Tokyo); 9: No. 10, 574-83(Oct 1972).

The thermal neutron spectra in light water of slab geometry poisoned with Cd and/or In were measured by the time-of-flight method, using a 20-MeV electron linear accelerator. The thermal spectra were simulated to those in the Pu built-up core of a commercial light water reactor corresponding to a fuel burnup of about 15,000 MWD/T. The results of measurements were compared with calculations based on the S_4 method using the Haywood scattering law. Fairly good agreement was obtained between the calculated and measured results except in a limited range of energy above the 0.176 eV resonance of Cd. It is concluded that the P_1 components of the source neutrons as well as the neutron scattering kernel play a significant role in the calculation of the thermal neutron spectra with large flux gradients, and that the scattering kernel of light water based on the Haywood model will be accurate enough to evaluate the infinite multiplication constant k_∞ of light water reactor cores with high fuel burnup within an error of about −0.17%, as estimated from the uncertainty in the spectrum calculation in the region above the Cd resonance. It is also emphasized from the two-dimensional S_4 calculations that the effect of reentrant hole perturbation should be evaluated quantitatively in the interpretation of the measured angular neutron spectra produced within finite media. (auth)

21958 SPACE-DEPENDENT VOID COEFFICIENT. Shani, G. (Negev Univ., Beersheba, Israel). Atomkernenergie; 20: No. 2, 160(Oct 1972).

The space-dependent void coefficient has been measured and calculated for a slab core, 1:1.5 UO_2/H_2O ratio reactor. The measurement took place at the Cornell University, zero power reactor. The void was a hollow 0.66'' diameter aluminum tube (a hollow fuel rod), inserted in the grid plate parallel to the fuel rods. In the core region the measurement was done in two steps: first the reactivity change by replacing fuel by moderator was measured, and then the reactivity change by replacing moderator by void was measured. In the reflector the void was replacing reflector material (water). (auth)

21959 CALCULATION OF PHYSICAL PARAMETERS FOR A THERMAL HETEROGENEOUS REACTOR BY THE SPECTROX METHOD. Rosu, A. M. (Inst. of Atomic Physics, Bucharest). Rev. Roum. Phys.; 17: No. 9, 1007-22(1972).

Some programs for the calculation of physical parameters for thermal, heterogeneous reactors are presented. The results obtained by applying these programs to lattices of different types, such as enriched uranium–graphite subcritical lattice as well as enriched uranium and natural uranium–water lattice of the HELEN Subcritical Assembly, are discussed. (auth)

21960 NEUTRON DENSITY FLUCTUATIONS IN A REACTOR SYSTEM. Taniguchi, A.; Sako, O. (Tokai Univ., Tokyo). Tokai Daigaku Kiyo Kogakubu; 1972: No. 1, 33-42(Sep 1972). (In Japanese).

A space- and velocity-dependent theory of the neutron density fluctuations in a reactor system is developed by the use of Lax's general formulation on the fluctuation of Markoffian variables from steady-state. First the transport event is introduced as one of the elementary processes, whose transition rate may be assumed to be $\delta(\nu'-\nu)\nu\cdot\nabla_r\delta(\tau'-\tau)$ then, by using the so-called master equation approach, stochastic equations, such as the transport equation and the equation for the space- and velocity-dependent correlation function of neutrons are derived. The applicability of this general theory is discussed concerning some simple reactor models i.e. the one-energy diffusion model and one-point reactor model. This formulation advantageously gives a result equivalent to that by Osborn and Natelson or by Dalfes, for example, from a more general and consistent point of view as compared with the specific approaches adopted by these authors. The result here is particularly compared with that obtained from Langevin techniques, which are based on a noise equivalent source, and the difference between them is discussed in detail. (auth)

21961 XENON POWER OSCILLATIONS IN A SPACE DEPENDENT MODEL WITH A TIME LAGGING POWER COEFFICIENT OF REACTIVITY. Elmeshad, Y.; Eltantawi, A. (Alexandria Univ., Egypt). Atomkernenergie; 20: No. 2, 95-8(Oct 1972).

A general theory is developed for the reactor stability in the presence of ^{135}Xe as a fission product and a time lagging power coefficient of reactivity. A spatial model is used for the analysis and the neutron flux density is described by a one group energy

model. A linearized system for small perturbation about the steady state is considered. The general theory can be used to obtain the stability conditions of gross power as well as spatial power distribution. The theory is applied to study power oscillation in both bare and perfectly reflected reactors. The cases of prompt as well as zero power coefficient of reactivity are obtained as special cases from the general theory. As a result of using a space dependent model for the study of stability of a bare reactor, it was possible to notice that the general destabilizing effect of decrease of the decay constant of the temperature at zero power is violated at a certain range of flux densities and values of the decay constant. (auth)

21962 NEUTRON FLUCTUATIONS IN THE SLOWING-DOWN PROCESS. THE CASE OF FERMI AGE APPROXIMATION. Taniguchi, A. (Tokai Univ., Tokyo); Sako, O.; Matsumura, H. Tokai Daigaku Kiyo Kogakubu; 1972: No. 1, 27-32(Sep 1972). (In Japanese).

A property of the fluctuation in a Markovian system is studied by using Lax's method. The Markovian system of concern is defined as a system which involves essentially one-body collisions or similar transition processes only and does not involve any branching processes. Fluctuations in a system so defined indicate no correlation either spatially or energetically at steady state, their magnitude being equivalent to the steady state value of the system in question. Consequently, information on the fluctuations in such a system is given by the steady state value. The Fermi-age equation is derived by using this approach; the fluctuations of neutron density are determined in a reactor core where the Fermi-age theory holds. (auth)

21963 CARONTE MODULAR SYSTEM: STATUS, APPLICATIONS, AND FUTURE DEVELOPMENTS. Mongini-Tamagnin, C. (CCR-EURATOM, Ispra, Italy). Energ. Nucl. (Milan); 19: No. 10, 627-32(Oct 1972). (In Italian).

The modular system CARONTE, developed at J. R. C. Euratom (Ispra), is described. This system is conceived to control the sequential automatic execution of a series of programs. (auth)

21964 CALCULATION OF THE SITE-DEPENDENT CORRELATION FUNCTION FOR A HOMOGENEOUS BARE CYLINDRICAL REACTOR. Pinter, Manfred (Technische Hochschule, Graz). Acta Phys. Austr.; 33: No. 3-4, 263-74(1971). (In German).

Computed is the position dependency of the second order correlation function for a bare cylindrical reactor. Starting initially with the generally valid form of the second order correlation function, as deduced by Borgwaldt and Stegemann, the general form is then specialized for the Rossi alpha experiment. To compute fission rate distribution as well as Green's functions, either the one or the two group diffusion theory is used. In addition, those simplifications are discussed that are permissible in the practical evaluation of experiments. (tr-auth)

21965 DETERMINATION OF THE REACTOR POWER RESPONSE TO A SINUSOIDAL REACTIVITY INPUT BY THE METHOD OF SMALL PARAMETER EXPANSION. Chandra, Subhash; Trasi, M. S. (Bhabha Atomic Research Centre, Bombay). Energ. Nucl. (Milan); 19: No. 8-9, 560-2(1972).

The reactor power response to a sinusoidal reactivity input is found for m groups of delayed neutrons by applying the small parameter technique to the integro-differential equation of reactor kinetics. This approach proves to be simpler than the ones previously employed. 4 references. (auth)

21966 VARIATIONAL THEORY AND FLUX SYNTHESIS WITH APPLICATIONS TO FAST REACTOR SPECTRUM CALCULATIONS. Price, W. G. Jr. Ann Arbor, MI; Univ. of Michigan (1972). 131p. University Microfilms Order No. 72-29,175.

Thesis.

Spectral Synthesis, the representation of the energy dependence of the neutron flux by a combination of overlapping trial modes, is applied to the analysis of fast reactors. The theoretical foundations of synthesis are investigated and an approximation procedure combining Spectral Synthesis with Wielandt's method which recovers the large savings expected with synthesis methods is developed. (Diss. Abstr. Int., B)

21967 PROBABILITY TABLE METHOD FOR TREATING UNRESOLVED NEUTRON RESONANCES IN MONTE CARLO CALCULATIONS. Levitt, L. B. (Atomics International, Canoga Park, CA). Nucl. Sci. Eng.; 49: No. 4, 450-7(Dec 1972).

A new method has been successfully applied to the analysis of fast critical assemblies in the VIM code. Cross section probability tables are appropriately distributed through the unresolved energy range of a given isotope. These tables consist of a probability distribution of cross sections to be used in an energy range surrounding the table energy. They are generated from point data sets obtained from ladders produced about a small energy range, sufficient to contain 50 to 100 resonances, insuring an adequate sampling of resonance interference and overlap effects while preventing significant variation in the energy dependent average parameters. The probability table method assumes that the resonance energies are sufficiently close that the neutron enters a resonance randomly, i.e., that the cross section seen by a neutron at one energy is in no way correlated with that at another energy. Cross sections are obtained rapidly from these tables during a Monte Carlo calculation by a random selection from the probability distribution described by the table assigned to the neutron energy, while storage requirements for a typical isotope are of the order of 1500 locations. The method has been thoroughly tested and appears to represent the unresolved region as well as the data permits while achieving computational efficiency in severely limited space. (auth)

21968 BURNUP OPTIMIZATION USING MODAL EXPANSION METHOD. Kitamura, Masaharu (Tohoku Univ., Sendai); Motoda, Hiroshi. J. Nucl. Sci. Technol. (Tokyo); 9: No. 9, 512-20(Sep 1972).

A method of modal expansion approximation is applied to study a burnup optimization problem. The spatial distribution of the neutron flux is approximated by a linear combination of certain predetermined spatial modes, and one of these modes is regarded as the control mode. A computational procedure that allows fast and sufficiently accurate estimation of the effect of flux shaping on the attainable burnup is described. As numerical example the optimal policy for flux shaping for a one-dimensional slab reactor model with nonlinear feedback effects is sought by this method. By manipulating the flux shape according to the optimal policy, the attainable burnup is increased appreciably over that obtained by the conventional method based on constant flux distribution, when the maximum allowable power peaking factor is large. The optimal policies are determined uniquely in the cases of highly non-uniform fuel loading and smaller values of the maximum allowable power peaking factor, while they become non-unique in the contrary case. The present method is applicable to more general problems such as the optimization of flux shaping of a reactor with multi-zone refueling scheme without much increase in computing effort. (8 references) (auth)

Core Thermal Hydraulics

21969 (AD-744006) TWO-PHASE VORTEX INVESTIGATION RELATED TO THE COLLOIDAL CORE NUCLEAR REACTOR. Final Report, September 15, 1970-December 9, 1971. Lewellen, W. S.; Stickler, D. B. (Massachusetts Inst. of Tech., Cambridge). Mar 1972. Contract F33615-71-C-1045. 47p. (ARL-72-37). NTIS.

Liquid containment in a gas-driven vortex has been investigated both experimentally and theoretically. Average air-water mixture densities greater than 100 times the thru-flow gas density were contained in a vortex chamber while maintaining the loss rate of water at that due to vaporization. Interaction studies indicate a stronger coupling of the liquid to the gas than of the liquid to the wall. Results are discussed in terms of their applicability toward estimating the potential performance of a colloidal core nuclear reactor. (auth)

21970 (FEI-249) USE OF A POROUS BODY MODEL FOR CALCULATING THE VELOCITY FIELD AND THE TEMPERATURE IN A REACTOR CORE. Kolmakov, A. P.; Yur'ev, Yu. S. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1971. 11p. (In Russian). INIS.

A system of differential equations in hydraulics and heat transfer was considered for a reactor core as a "porous body" with anisotropic properties. This system of equations was solved in a linear approximation for the case of small deviations from the channel geometry. (tr-auth)

21971 (KFK-1605) MISTRAL-II: THERMOHYDRAULIC MIXED FLOW ALGORITHM FOR ROD BUNDLES. Baumann, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente). Jan 1972. 75p. (In German). Dep. NTIS (U. S. Sales Only).

A new version of the MISTRAL-code is presented. It permits the thermohydraulic calculation of the temperature- and mass flow distributions in hexagonally arranged fuel rod bundles on the condition of an individual power specification in all rod positions. The energy exchange between the channels by means of mixing and heat conduction of the coolant as well as flow sweeping caused by helical spacers at the wall of the fuel box are included. The size of the bundle can be chosen between 7 and 217 rods. (auth)

21972 DIVISION INTO SUBCELLS AND INDEXING OF HEXAGONAL TUBE BUNDLES WITH SPECIAL REGARD TO TWELVEFOLD SYMMETRIES. Ullrich, R. (Univ., Hamburg). Atomkernenergie; 20: No. 2, 99-101(Oct 1972). (In German).

A method for calculating automatically the indices of single subcells characterizing their position in finite hexagonal fuel rod bundles with an arbitrary number of rods is proposed. The advantages of this method are: proportionality to cartesian coordinates, clarity, and unequivocal simplicity in view of the determination of adjacent cells. As an example the characteristic twelfth of a bundle is partitioned into ten types of specific subcells. Their interrelations and geometric parameters are determined by a computer program, which in addition calculates the position of equidistant collocation points located along the cell surfaces, and needed for thermal and hydraulic analysis in fuel rod bundles under certain circumstances. (auth)

21973 REACTOR DYNAMICS CALCULATIONS FOR REACTORS WITH NATURAL CIRCULATION OF SINGLE PHASE COOLANT. Selivanov, V. M.; Gorev, A. A.; Sidorova, I. I.; Gribunin, V. M. This paper was summarized in At. Energ. (USSR); 31: No. 5, 505(Nov 1971) as paper No. 533/6269. (In Russian).

Full copy of this paper is held by TIC.

The nonlinear mathematical model of the dynamics of the primary loop of a water-cooled water-moderated reactor with natural circulation of single-phase coolant is discussed. The solution of the nonstationary heat transfer equations is represented by an expansion in orthogonal Legendre polynomials with time-varying coefficients. (auth)

21974 INVESTIGATION OF THE CROSS CORRELATION FUNCTION OF COOLANT TEMPERATURE FLUCTUATIONS VIA THE AXIAL DEPENDENT TWO POINT MODEL OF HEAT TRANSFER. Kosaly, G.; Mesko, L. (Central Research Inst. for Physics, Budapest). Atomkernenergie; 20: No. 2, 91-4(Oct 1972).

The cross correlation function between coolant temperature fluctuations at two different axial positions is calculated using the axial dependent two point model of heat transfer. The contribution of the power fluctuations is estimated in a concrete case and the behavior of the correlation function is explained for different values of the relevant parameters. (auth)

21975 HOT SPOT EXPECTATION IN NUCLEAR REACTOR CORE THERMAL DESIGN. Amendola, A. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Sci. Eng.; 49: No. 1, 106-8 (Sep 1972).

The previous hot spot statistical analysis was extended to a more complete assessment of the reliability of a reactor core against over-temperatures. A simple procedure allows the designer to evaluate the expected number of hot spots and the average number of pins and subassemblies in which they occur. The influence of the different types of uncertainties on these quantities is examined. (auth)

GENERAL

Energy Economics

Refer also to abstract 21365.

21976 (AEC-tr-7405) CENTRAL HEATING AND POWER PLANT NO. 21 (CHPP). Translated from Russian. 9p. Dep. NTIS.

The Central Heating and Power Plant No. 21 (CHPP) began operation in 1963 and supplies heat and electricity to Moscow and the adjacent region of Moscow Oblast'. Heat energy from CHPP is supplied with hot water for heating and ventilating residential and industrial buildings, as well as furnishing hot water. Technical characteristics of the electrical station and power equipment boiler are given. (JCW)

21977 (NP-19658) AN INQUIRY INTO BIOLOGICAL ENERGY CONVERSION. Hollaender, A.; Monty, K. J.; Pearlstein, R. M.; Schmidt-Bleek, F.; Snyder, W. T.; Volkin, E. (Tennessee Univ., Knoxville). Dec 1972. 42p.

Three promising areas in which biological processes might be applied to the effort to expand energy supplies were explored. Algal or microbial photosynthesis could be used to produce molecular hydrogen, with water as the primary source of atomic hydrogen and sunlight as the energy source. The economics of hydrogen production by photosynthesis involve the large-scale growth of algae (and/or bacteria), for which some parameters have already been measured, the obvious investment of the land areas large enough to trap the required solar energy, and such unknown details as the cost and lifetime of isolated enzyme reactors and the ultimate efficiency of managed populations of organisms. The second possibility is the production of methane by certain groups of bacteria that are able to reduce alcohols, aldehydes, or carboxylic acids during anaerobic growth, with methane as a major fermentation product. The economics of such processes will be related to the regional availability of large quantities of suitable organic wastes and the availability of a moderate-temperature heat source. The third area involves the use of microorganisms to facilitate the processing of certain fossil fuels that heretofore have been considered economically untouchable such as the bacterial oxidation of the sulfur indigenous to certain shale deposits and biological attacks to convert tarry deposits to more tractable chemical forms. (JCW)

21978 (ORNL-EIS-73-52(Vol.1)(No.2)) NSF-RANN ENERGY ABSTRACTS. A Monthly Abstract Journal of Energy Research. Guthrie, M. P. (ed.) (Oak Ridge National Lab., Tenn). Feb 1973. Contract W-7405-eng-26. 13p. Dep. NTIS.

The bibliography, in general, covers research on energy sources, electric power (generation, supply and demand, transmission, environmental impact, and use), and energy (production, consumption, supply and demand, and policy). The research publications cited are technical journal articles, popular or semi-technical magazine articles, topical reports, progress reports, symposium papers and proceedings, monographs, and books. (JCW)

21979 (STI/PUB-300(Vol.1)) PEACEFUL USES OF ATOMIC ENERGY, VOLUME 1. Proceedings of the Fourth International Conference, Geneva, 6-16 September 1971. (International Atomic Energy Agency, Vienna (Austria)). 1972. 877p. (In several languages). (CONF-710901-(Vol.1)). IAEA $14.00.

This volume contains opening and closing speeches; special talks; world energy needs and resources and the role of nuclear energy; work of national and international organizations; and narrative of the exhibits. All of the technical papers have appeared previously in NSA: see NSA Vol. 25, No. 22. (LMT)

21980 (UCRL-51340) ECONOMIC ESTIMATES OF THE LAWRENCE LIVERMORE LABORATORY CONCEPT OF IN-SITU COAL GASIFICATION. Stephens, D. R. (California Univ., Livermore. Lawrence Livermore Lab.). 7 Feb 1973. Contract W-7405-Eng-48. 12p. Dep. NTIS.

For a description of the Lawrence Livermore Lab. in situ coal gasification concept see UCRL-51217(Rev.1) (NSA 27: 235). Two cases, to cover the extremes of expected gas qualities, are calculated here. In the first, only CO_2 removal was considered to be needed to produce pipeline-quality gas; and, in the second, surface facilities for sulfur removal and methanation, in addition to CO_2 scrubbing, were required. Capital investment and operating costs for the two cases are presented. In addition, a sample cash-flow calculation is shown, a graph summarizes gas selling price vs internal rate of return, with royalties and depletion allowances for gas and for coal. All cases considered are based on an annual production of 100 billion scf of pipeline gas, an underground pressure of 450 psi, and enough oxygen to burn 20% of the coal. All costs are in 1971-1972 dollars. (LMT)

21981 (WASH-1230(Vol. 4)). 1000-MWe CENTRAL STATION POWER PLANTS INVESTMENT COST STUDY. Volumn IV. Oil-fired fossil plant. (United Engineers and Constructors Inc., Philadelphia, Pa). Jun 1972. Contract AT(30-1)-3032. 123p. Dep. NTIS.

This report on the Middletown Power Generating Station (oil-fired 1000-MWe central station) is one of a series of investment cost studies and results from a modification for fossil plants of Appendix A of "Guide for Economic Evaluation of Nuclear Reactor Plant Designs," report NUS-531. Information of this report is grouped under the following sections: (1) Site and Environment, (2) Technical Description of Plant, (3) Equipment List, (4) List of Drawings, and (5) Estimate of Cost. (JCW)

21982 BROWN-OUT. The Power Crisis in America. Rogers, W. New York; Stein and Day (1972). 300p. $7.95.

The annual power shortages will continue and worsen if the consumption of power is not controlled. There is little doubt that the expansion of power production and consumption, which the utilities insist is necessary to their economic well-being, and the uninterrupted growth of industrial capacity invite ecological disaster. The predicament of the power companies—a predicament involving the utilities themselves and the government—and the people whom both are supposed to serve are discussed. (JCW)

Law

Refer also to abstracts 20418 through 20422.

Management

21983 (ANL/ES-21) ENVIRONMENTAL MANAGEMENT OF FEDERAL FACILITIES. Hoover, L. J.; Norco, J. E.; Reisenweber, R. L. (Argonne National Lab., Ill.). Jan 1973. Contract W-31-109-Eng-38. 160p. Dep. NTIS.

The three alternative environmental management programs described include identification of roles; environmental information systems; resource requirements; and a comparison of the alternatives. The alternatives place varying degrees of responsibility on the Environmental Protection Agency, state and local pollution con trol agencies, and the federal facilities. (auth)

21984 (BNWL-SA-4589) CHECK LIST FOR RADIOLOGICAL EMERGENCY PREPAREDNESS. Unruh, C. M. (Battelle Pacific Northwest Labs., Richland, Wash). Jan 1973. 13p. Dep. NTIS.

A check list was developed for use in planning for handling radiation accidents. The course of the accident response was identified by twelve areas of action, including detection of emergency; evacuation; rescue of people involved; communications; medical treatment and assistance; control of accident area; stabilization of accident area; control center; analyses of accident; dosimetry; technical assistance; and information. Each of these areas of action is discussed separately in the terms of a major accident. This format of organization leads to some redundancy; however, it is hoped this redundancy will lead to reenforcement of certain needs and not detract from the important needs of radiological emergency preparedness plans. (CH)

21985 (UCRL-50007-72-2). HAZARDS CONTROL PROGRESS REPORT No. 43, MAY-AUGUST 1972. (California Univ., Livermore. Lawrence Livermore Lab.). 30 Oct 1972. Contract W-7405-Eng-48. 31p. Dep. NTIS.

Routine radiation protection and safety activities during the period of May through August 1972 are reported. A list is included of recent publications that report the results of research studies. (CH)

Mathematics and Computers

21986 (ANL-7995) INTRODUCTION TO SPEAKEASY. Cohen, S.; Vincent, C. M. (Argonne National Lab., Ill.). Jan 1973. Contract W-31-109-eng-38. 99p. Dep. NTIS.

21987 (BARC-623) FOURIER ANALYSIS AND DIGITAL FILTERING. Datt, Ram (Bhabha Atomic Research Centre, Bombay (India)). 1972. 23p. Dep. NTIS (U. S. Sales Only).

21988 (UCID-30051) CIE MEETING NO. 120: COMPUTER SCIENCE EDUCATION AT CARNEGIE-MELLON UNIVERSITY. Traub, J. F. (California Univ., Livermore. Lawrence Livermore Lab.). 17 Aug 1972. Contract W-7405-eng-48. 16p. Dep. NTIS.

The major components of the computer science education program at Carnegie-Mellon University are discussed. Information is included on aspects of student orientation, directed research, core qualification, and area qualification. (JRD)

21989 TRENDS IN ON-LINE COMPUTER CONTROL SYSTEMS. Conference held at Sheffield, Eng., April 18–20, 1972. IEEE Conference Publication No. 85. London; Institute of Electrical Engineers (1972). 222p. £8. (CONF-720449).

Thirty one papers were presented of which two were in NSA Scope and for which separate abstracts were prepared. (UK)

For abstracts of individual papers see: 21643 and 21901.

Miscellaneous

21990 (AEC-tr-7102/7-8) NUKLEONIKA. Translation of Nukleonika; 15: No. 7-8, 499-584(1970). 79p. (TT-70-55010/7-8). Dep. NTIS.

21991 (BDX-613-697(Rev.)) ROLAMITE SENSORS. Final Report. Berry, C. W. Jr. (Bendix Corp., Kansas City, MO). Dec 1972. Contract AT(29-1)-613. 39p. Dep. NTIS.

21992 (BNWL-SA-4104) PACKARD 45 TO DECTAPE COUPLER. Ratcliffe, C. A. (Battelle Pacific Northwest Labs., Richland, Wash). Oct 1971. Contract AT(45-1)-1830. 4p. (CONF-720306-9). Dep. NTIS.

From Scintillation and Semiconductor Counter Symposium; Washington, District of Columbia, United States of America (USA) (1 Mar 1972).

21993 (CEA-Bib-1001(1970)) CUMULATIVE LIST OF C. E. A. NOTES. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Sep 1971. 70p. (In French). Dep. NTIS (U. S. Sales Only).

21994 (COO-2216-1) STUDIES ON MAMMALIAN DNA. Progress report, May 1, 1972–April 30, 1973. Prescott, D. M. (Colorado Univ., Boulder). 1973. Contract AT(11-1)-2216. 6p. Dep. NTIS.

21995 (COO-3151-19) HEAT PULSE PROPAGATION IN DIELECTRIC SOLIDS. Beck, H.; Beck, R. (Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics; Zurich Univ. (Switzerland)). 1972. Contract AT(11-1)-3151. 40p. Dep. NTIS.

21996 (COO-3417-29) DNA POLYMERASE ACTIVITY IN ANTERIOR PITUITARY GLANDS OF MALE RATS: EFFECTS OF AGE AND ESTRONE TREATMENT. Mastro, A.; Hymer, W. C. (Pennsylvania State Univ., University Park. Dept. of Biology). 1972. Contract AT(11-1)-3417. 41p. Dep. NTIS.

21997 (COO-3534-18) EXPERIMENTAL STUDY OF LEAF DEVELOPMENT IN CERTAIN OF VASCULAR PLANTS. Final Report. Kuehnert, C. C. (Syracuse Univ., N. Y. Dept. of Biology). Jan 1973. Contract AT(11-1)-3534. 20p. Dep. NTIS.

21998 (GAT-P-55) FIELD REPAIRS OF EHV BUSHING OIL LEAKS. Ondera, A. W.; Parrish, C. (Goodyear Atomic Corp., Piketon, Ohio). 25 Jan 1973. Contract AT(33-2)-1. 7p. Dep. NTIS.

21999 (IAE–2160) SOME CHARACTERISTICS OF RADIATION COLLISIONS. Gudzenko, L. M.; Yakovlenko, S. I. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 20p. (In Russian). Dep. NTIS (U. S. Sales Only).

22000 (INP–802) FOURTH ALL POLISH SEMINAR ON THE THEME OF NUCLEAR MAGNETIC RESONANCE IN PRACTICE. (Institute of Nuclear Physics, Krakow (Poland)). Dec 1971. 191p. (In Polish). Dep. NTIS (U. S. Sales Only).

Eighteen papers and one abstract involving the use of NMR (primarily radiospectroscopic methods) are presented. Most of the papers are concerned with structure studies of compounds (most of them organic compounds); one paper is devoted to a theoretical analysis of an early paper on NMR by Bloembergen, Purcell, and Pound (Phys. Rev., 73: 679(1948)). (LMT)

22001 (ITF-72-147-P) TOPOLOGY OF BIANCHI UNIVERSES. I. Osinovskii, M. E. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 27p. (In Russian). Dep. NTIS (U. S. Sales Only).

22002 (JINR-E12-6779) CORRELATION BETWEEN THE OVERALL STABILITY CONSTANTS OF METAL COMPLEXES. VIII. THE EFFECT OF THE IONIC STRENGTH OF THE SOLUTION. Mihailov, M. H. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 26p. Dep. NTIS (U. S. Sales Only).

22003 (JINR-P14-6731) ON THE PrF_3 STRUCTURE. Zlokazov, V. B.; Savenko, B. N.; Henning, K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1972. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

The PrF_3 structure was studied at the pulsed fast reactor IBR-30 with the aid of neutron diffraction. Various space groups are suggested for interpretation of the LaF_3 structure: D^3_{3h}, D^4_{3d}, and C^3_{3v}. The data obtained for PrF_3 agree well with the D^4_{3d} structure. (auth)

22004 (JUL-888-ME) MENADOINE AND UBIQUINONE IN HUMAN METABOLISM. Ritzl, F. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Medizin). Sep 1972. 78p. (In German). Dep. NTIS. (U. S. Sales Only).

Thesis. Submitted to Duesseldorf Univ., West Germany.

22005 (KFK-1670) REPORT ON RESEARCH AND DEVELOPMENT ACTIVITIES DURING THE YEAR 1971. (Gesellschaft Fuel Kernforschung m.b.H., Karlsuhe (West Germany)). Feb 1972. 258p. (In German). INIS.

This first part of the annual report 1971 contains the detailed accounts of the several institutes and departments of their scientific activities, including reports on the various projects. Representing a means to assess the effectiveness of the scientific activities, this report will serve as a working basis for the deliberations and decision-making processes within the advisory and managing bodies of the Gfk with respect to the research and development programmes for the year 1973, and will likewise serve as a valuable source of information and as an invitation to cooperation for scientists both inside and outside the Center. (INIS)

22006 (LA-DC-1229) INTENSITY-DEPENDENT OPTICAL FILTER. Thorne, J. M.; Loree, T. R.; McCall, G. H. (Los Alamos Scientific Lab., N. Mex.). 1972. 10p. (CONF-721067-1). Dep. NTIS.

22007 (NP-19644) ANNUAL REPORT: 1970. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1970. 110p. (In Spanish). Dep. NTIS. (U. S. Sales Only).

After a brief resume of the origin and evolution of National Commission of Atomic Energy (CNEA), the year's activities are summarized under the following sections: (1) Energy Program (Atucha nuclear power station, facilities development, nuclear fuels, and raw materials); (2) Applications (radionuclide production, utilization of radionuclides and radiations, and intense radiation sources); (3) Developments (in reactors; physics; chemistry; biology, medicine, and agriculture; instrumentation; and metallurgy); (4) Radiological Protection and Safety; (5) Administration and Finance; (6) Infrastructure and General Aspects (international and public relations; training and technical information; and civilian works, general workshops and maintenance); and (7) Publications. (LMT)

22008 (NRC-TT-1599) INVERTED = RIGHT? THE PROBLEM OF ROOF INSULATION AND WATERPROOFING. Spieker, H. Translated by R. Serre from 62: No. 6, 226-233(1971). 14p. Dep. NTIS (U. S. Sales Only).

22009 (NRC-TT-1616) POLYCHLORINATED BIPHENYLS (PCB): AN ENVIRONMENTAL HEALTH PROBLEM. Experiments with the Synthesis of Tetrachlorobiphenyl (Labelled ^{14}C) for Toxicological and Method Studies. Melvas, B. Translated by S. W. Stillich from Nord. Hyg. Tidskr.; 52: No. 1, 40-44(1971). 7p. Dep. NTIS (U. S. Sales Only).

22010 (NRC-TT-1617) DISTRIBUTION AND METABOLISM OF T_4 - ^{125}I AND T_3 - ^{125}I IN RATS. Doglio, R.; Dogliotti, L.; Fonzo, D.; Bajardi, P.; Mussa, A.; Lauro, R. Translated by Y. Peluso from Boll. Soc. Ital. Biol. Sper.; 43: No. 10, 574-578 (1967). 11p. Dep. NTIS (U. S. Sales Only).

22011 (NRC-TT-1618) OBSERVATIONS ON THE DISTRIBUTION AND METABOLISM OF T_3 - ^{125}I IN MAN. Lauro, R.; Doglio, R.; Dogliotti, L.; Negri, G. L. Translated by Y. Peluso from Boll. Soc. Ital. Biol. Sper.; 43: No. 10, 578-581(1967). 6p. Dep. NTIS (U. S. Sales Only).

22012 (NYO-3644-12) ION EXCHANGE RESINS AND LASER CHEMISTRY. Final Report, December 1965 – December 31, 1971. Wiley, R. H. (Hunter Coll., New York). 3 Jan 1973. Contract AT(30-1)-3644. 24p. Dep. NTIS.

22013 (ORNL-NSF-EP-31) 1952 COUNTY AND CITY DATA BOOK: CUMULATIONS TO OBE AREAS. Olsen, R. J.; Westley, G. W. (Oak Ridge National Lab., Tenn.). Jan 1973. Contract W-7405-eng-26. 87p. Dep. NTIS.

22014 (ORNL-NSF-EP-32) 1956 COUNTY AND CITY DATA BOOK: CUMULATIONS TO OBE AREAS. Olsen, R. J.; Westley, G. W. (Oak Ridge National Lab., Tenn.). Jan 1973. Contract W-7405-eng-26. 83p. Dep. NTIS.

22015 (ORNL-NSF-EP-33) 1962 COUNTY AND CITY DATA BOOK: CUMULATIONS TO OBE AREAS. Olsen, R. J.; Westley, G. W. (Oak Ridge National Lab., Tenn.). Jan 1973. Contract W-7405-eng-26. 97p. Dep. NTIS.

22016 (ORNL-NSF-EP-34) 1967 COUNTY AND CITY DATA BOOK: CUMULATIONS TO OBE AREAS. Olsen, R. J.; Westley, G. W. (Oak Ridge National Lab., Tenn.). Jan 1973. Contract W-7405-eng-26. 89p. Dep. NTIS.

22017 (ORNL-NSF-EP-35) COUNTY CODE EQUIVALENTS FOR REGIONAL ECONOMIC ANALYSIS. Olsen, R. J.; Westley, G. W. (Oak Ridge National Lab., Tenn.). Jan 1973. Contract W-7405-eng-26. 98p. Dep. NTIS.

22018 (ORNL-TM-4011) STUDY OF HYDRODYNAMIC ASPECTS OF REVERSE OSMOSIS (HYPERFILTRATION). Final Report. Sheppard, J. D.; Hayes, P. H.; Griffith, W. L.; Keller, R. M.; Thomas, D. G. (Oak Ridge National Lab., TENN). Jan 1973. 272p. Dep. NTIS.

22019 (ORNL-TM-4033) ORNL COMPUTER NETWORK. Winkler, D. R.; Hammons, C. E. (Oak Ridge National Lab., Tenn). Feb 1973. Contract W-7405-eng-26. 36p. Dep. NTIS.

22020 (ORNL-TM-4068) METALLOGRAPHIC EXAMINATIONS OF RETRIEVED INTRAMEDULLARY BONE PINS AND BONE SCREWS FROM THE HUMAN BODY. Gray, R. J. (Oak Ridge National Lab., Tenn.). Feb 1973. Contract W-7405-eng-26. 34p. Dep. NTIS.

22021 (RFP-Trans-129) ROTATION OF THE THUMB ON ITS LONGITUDINAL AXIS DURING OPPOSITION: A GEOMETRICAL AND MECHANICAL STUDY OF THE TRAPEZIO-METACARPAL (USING A MECHANICAL MODEL OF THE HAND). Kapandji, A. Translated for Dow Chemical U. S. A., Rocky Flats Div., from Rev. Chir. Orthoped. Reparatrice App. Meteur; 58: No. 4, 273-289(1972). 20p. Dep. NTIS.

22022 (SC-DR-720750) SOME ASPECTS OF PHOTOCONDUCTIVITY IN GEOLOGICAL MATERIALS. Ewing, R. L. (Sandia Labs., Albuquerque, N. Mex.). Feb 1973. 12p. Dep. NTIS.

22023 (SC-DR-720804) REPORT OF THE FREE IMPACT VELOCITY EXPERIMENTS (FIVE). Fisher, L. A.; Hereford, W. V. (Sandia Labs., Albuquerque, N. Mex). Jan 1973. 49p. Dep. NTIS.

22024 (SC-DR-720918) CDC 6600 CODES FOR THE ERROR FUNCTION, CUMULATIVE NORMAL, AND RELATED FUNCTIONS. Amos, D. E.; Daniel, S. L. (Sandia Labs., Albuquerque, N. Mex.). Dec 1972. 27p. Dep. NTIS.

22025 (SLA-73-6) RESPONSE OF A THREE-LAYERED RING TO AN AXISYMMETRIC IMPULSE. Sagartz, M. J. (Sandia Labs., Albuquerque, N. Mex.). Jan 1973. 26p. Dep. NTIS.

22026 (SLA-73-193) ACTIVE ELEMENTS FOR HIGH-POWER LASERS USING NEODYMIUM GLASS. (Akademiya Nauk SSSR, Moscow. Fizicheskii Institut). Translated by P. Newman. (Sandia Labs., Albuquerque, NM), from Preprint No. 87. 29 Jun 1971. 9p. Dep. NTIS.

22027 (SLA-73-194) NONLINEAR AMPLIFICATION OF HIGH-POWER LIGHT PULSES IN ACTIVE MEDIA SHAPED LIKE FUNNELS. (Akademiya Nauk SSSR, Moscow. Fizicheskii Institut). Translated by P. Newman (Sandia Labs., Albuquerque, NM), from Preprint No. 132. 5 Sep 1972. 44p. Dep. NTIS.

22028 (SU-326-P-30-23) METHODS FOR MODIFYING MATRIX FACTORIZATIONS. Gill, P. E.; Golub, G. H.; Murray, W.; Saunders, M. A. (Stanford Univ., Calif. Dept. of Computer Science). Nov 1972. Contract AT(04-3)-326. 60p. Dep. NTIS.

22029 (UCLA-34-P-61-X-14) METABOLIC CONTROL OF SALT TRANSPORT IN PLANT TISSUES. Progress Report, January 1, 1972 – December 31, 1972. Laties, G. G. (California Univ., Los Angeles). [nd]. Contract AT(04-3)-34. 4p. Dep. NTIS.

22030 (UCLA-34-P-201-3) FIRST REPORT ON FOREIGN TRAVEL FOR THE PERIOD JANUARY 1, 1972–DECEMBER 31, 1972. deFontaine, D. (California Univ., Los Angeles. Dept. of Materials). Sep 1972. Contract AT(04-3)-34. 32p. (UCLA-ENG-7291; CONF-720814-4). Dep. NTIS.

From 9th general assembly and international congress of crystallography; Kyoto, Japan (26 Aug 1972).

About one-thousand abstracts were submitted and 750 of these were presented orally at the Congress. The text of all abstracts was published as a supplement to Acta Crystallographica, Vol. A28, Part S4, July 15, 1972. The table of contents of the Collected Abstracts is reproduced here and contains a diversity of topics: biological structures, metals, glasses, liquids, structure determination, phase transformations, crystal growth, lattice defects, instrumentation (x-ray, neutron, electron diffraction, optics, computer techniques, etc...), to name but a few. (auth)

22031 (UCRL-51130(Vol.9)) FINAL REPORT ON THE DEVELOPMENT OF THE GEOGRAPHICAL POSITION LOCATOR (GPL). Volume 9. WISPIN: An Inertial Navigation System Simulation Program. Franklin, P.; Henderson, R. H. (California Univ., Livermore. Lawrence Livermore Lab.). 24 Sep 1971. Contract W-7405-eng-48. 186p. Dep. NTIS (U. S. Sales Only).

22032 (UCRL-51276) SOME COMPUTATIONAL ASPECTS OF TRANSIENT ELECTROMAGNETICS. Miller, E. K. (California Univ., Livermore. Lawrence Livermore Lab.). 19 Sep 1972. Contract W-7405-eng-48. 97p. Dep. NTIS.

22033 (UCRL-74005) COMPUTATIONAL ASPECTS OF SOLVING PLANAR INTEGRAL EQUATIONS BY REGULARIZATION. Ekstrom, M. P. (California Univ., Livermore. Lawrence Livermore Lab.). 30 Oct 1972. 7p. (CONF-721133-1). Dep. NTIS.

From 6th Asilomar Conference on Circuits and Systems; Pacific Grove, California, United States of America (USA) (15 Nov 1972).

22034 (UCRL-Trans-10656) LASER INSTALLATION WITH A RADIATION ENERGY OF UP TO 10 kJ FOR STUDYING THE INTERACTION OF POWERFUL LIGHT FLUXES WITH MATTER. Batanov, V. A.; Ershov, B. V.; Maksimov, L. P.; Savranskii, V. V.; Fedorov, V. B. Translated from Kratk. Soobshch. Fiz.; No. 4, 8-14(1970). 7p. Dep. NTIS.

22035 (Y-UB-1(Rev.1)) EXPERIENCE WITH THE OAK RIDGE CENTRALIZED SANITARY LANDFILL. Speas, I. G. (Oak Ridge Y-12 Plant, Tenn. (USA)). 1972. Contract W-7405-eng-26. 15p. (CONF-721030-6). Dep. NTIS.

From Conference on pollution control and abatement at AEC facilities; Oak Ridge, Tennessee, USA (25 Oct 1972).

22036 LASER BALANCING SYSTEM (24 Jan 1973) (ENGINEERING MATERIALS). (Bendix Corp., Kansas City, MO). (CAPE-2319).

22037 REGENERATIVE FEEDBACK LOOP (ENGINEERING MATERIALS). (Illinois Univ., Urbana. Materials Research Lab.). (Cape – 2318).

22038 AIR BEARING LVDT TRANSDUCER (ENGINEERING MATERIALS). (CAPE – 2324).

22039 INTERFACE FOR DESK CALCULATOR (ENGINEERING MATERIALS). (CAPE – 2322).

22040 INTERFACE FOR COMPUTER TO SPECTROGONIOMETER (ENGINEERING MATERIALS). (CAPE-2323).

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London, National Reference Library

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